APPLICATION GUIDE FOR THE PREPARATION OF DETAILED COMMON CONTROL CENTRAL OFFICE EQUIPMENT REQUIREMENTS

CONTENTS

1. GENERAL

1.1 Purpose

1.11 This section provides REA borrowers, consulting engineers, suppliers, and other interested parties with technical information for use in the design and construction of REA borrowers' telephone systems. It covers, in particular, the preparation of Part III, REA Form 524c, Specification for Common Control Central Office Equipment, Detailed Equipment Requirements.

1.12 The General Specification, REA Form 524a, which forms a part of REA Common Control Central Office Equipment Contracts, REA Forms 525 and 545, establishes minimum performance requirements and capabilities for common control central office equipment to be supplied for use in the telephone systems of REA borrowers. However, the many variables involved make it impractical to devise a single overall specification for common control central office equipment which will insure the provision of adequate and appropriate facilities to fit every situation. Accordingly, Part III, "Detailed Equipment Requirements," REA Form 524c, was prepared to permit the particular arrangements and requirements for individual offices to be specified to prospective suppliers of the equipment. The "Detailed Requirements" are based upon the premise that the central office equipment is in compliance with the General Specification. Therefore, prior to preparation of the "Detailed Requirements," the General Specification should be consulted.

1.13 Most of the items covered by REA Form 524c are those that have purposely been left flexible in the General Specification in order to meet the requirements of individual situations. (In some instances it may become necessary to deviate from the basic requirements established in the General Specification. Such deviation should be strictly limited to obtaining all the features required for each situation. They should be shown in detail in Part III and will supersede the requirements established in Part I, General Specification.)

1.14 In preparing a specification for common control central office equipment it will be helpful for the engineer to review the following sections of the REA Telephone Engineering and Construction Manual, even though most of them do not relate directly to common control types of offices:

REA TE&CM 156 - "Nationwide Operator Toll Dialing"
REA TE&CM 157 - "Customer Toll Dialing"
REA TE&CM 205 - "Preparation of an Area Coverage Design"
REA TE&CM 212 - "Ringing Systems"
REA TE&CM 319 - "Interoffice Trunking and Signaling"
REA TE&CM 326 - "Application Guide for the Preparation of Part III - Specification - Detailed Toll Office Equipment Requirements"
REA TE&CM 424 - "Design of Two-Wire Subscriber Loop Plant"
REA TE&CM 703 - "Pay Station Services"

1.15 The Area Coverage Design (ACD) (or Supplemental Loan Proposal - see REA Bulletin 320-14) for the project should be studied carefully and used as a reference. However, because of the possibility that some of the information therein may require updating to include recent changes, current information should be used in preparing Part III. If this information differs from that in the ACD or Supplemental Loan Proposal, it shall be submitted to REA with the plans and specifications for approval.

1.16 The engineer should be familiar with the latest issue of the American Telephone and Telegraph Company's "Notes on Distance Dialing" (the "Blue Book").

1.17 Throughout this Guide, wherever some action is specified to be taken by the "Owner," the words "or its engineer" shall be considered to be implied.

1.2 Inclusion of DDD and ANI

1.21 Since practically all common control central offices will be arranged for some form of automatic line identification for charging purposes, and for direct distance dialing, information regarding these features is included in the basic common control specification, REA Form 524. REA Form 537, "Specification for Automatic Number Identification Equipment," and REA Form 538,

"Specification for Direct Distance Dialing Equipment," must be completed where ANI or toll ticketing is to be provided.

1.22 The "General Specification for Common Control Central Office Equipment" may be used for toll centers; that is, Class 4 offices in the Nationwide Toll Dialing Plan, but is primarily intended for tributaries (Class 5 offices). When used for a new toll center, it will be desirable to include in the same contract REA Form 542, "Toll Board Specifications," covering the specifications for the desired manual toll switchboard positions (or Traffic Service Desks, Positions, or Consoles), as well as REA Form 538, "Specification for Direct Distance Dialing Equipment," for toll ticketing equipment. When the specification is used for a tributary office, recording of the charging information may be either in the local office or in a tandem office or toll center of the REA borrower or another telephone company.

1.23 In some instances borrowers with several tributaries (Class 5 offices) will want to use equipment to forward the ticketing information to one central location where the recording equipment is located. In situations of this type, tandem switching of toll calls will be necessary in the ticketing office, at least for toll calls originating in the borrower's tributaries. For transmission purposes the tandeming office should be considered as a Class 4 office. The tandem office must have the necessary impedance compensators, switching pads, proper ratio repeating coils, and other transmission apparatus associated with a Class 4 office. Such an arrangement will require agreement with the connecting company and will require a direct connection with a Class 3 switching center.

1.3 Explanation of Parts III and IV

1.31 The internal organization of common control central office switching systems may vary widely among different types of systems. It would be difficult, if not impossible, for the borrower or its engineer to determine the proper quantities of various types of switching network and common control equipment necessary to meet a specific situation for each of the systems offered by various suppliers.

1.32 To care for the situations outlined in paragraph 1.31 above, two sections are included as Parts III and IV of the "General Specification for Common Control Central Office Equipment." Part III includes all of the information available to the borrower and its engineer in regard to the traffic and equipment requirements for a specific central office. Part IV provides space for the supplier to complete the information which only he can provide in regard to switching network and common control equipment quantities and heavy traffic delays.

1.33 The borrower or its engineer will complete Part III and submit a copy of this, together with a blank copy of Part IV, to each supplier whom he wishes to bid on the project.

1.34 Each supplier submitting a bid will be expected to fill out and return Part IV with its bid.

1.35 When a final decision is made as to which type of equipment is to be ordered, both Parts III and IV will become integral parts of the contract.

1.4 Explanation of Numbers in Parentheses

1.41 Paragraph numbers shown in parentheses refer to the paragraphs in Part III of the specification.

1.5 Attended or Unattended Operation

1.51 Each central office should be designated as "attended" or "unattended" by checking the appropriate square in the box at the top of page 1 of Part III. An "attended" office is one where an attendant able to relay a trouble signal is available at all times. A dial office located in a building which also houses a toll board would be considered "attended." An office is also considered to be "attended" if the maintenance man lives nearby and has all alarms indicated in his home when he is not at the office.

1.6 Numbering Scheme

1.61 (Paragraph 1.6)

1.611 It has become increasingly important with the advent of inter-toll dialing to give serious consideration to the numbering scheme to be used in any area. There are so many details that the subject of numbering cannot be covered in this section. The subject is discussed at length in the latest issue of the American Telephone and Telegraph Company's "Notes on Distance Dialing," as well as in REA TE&CM 156, "Nationwide Toll Dialing," and TE&CM 208, "Local Exchange Numbering Plans and Selector Level Assignments." It should be noted that selector level assignments need not be considered in determining the numbering plan for a common control central office.

1.612 Universal numbering is also important for the numbering scheme adopted if present or future EAS is involved.

1.62 (Paragraph 1.61)

1.621 Each office must have a separate three-digit numerical office code, which shall be assigned from a list maintained by the Bell System, in order that the central office equipment may be designed for operation with the nationwide toll dialing plan. This code should be obtained from the connecting company (whether Bell or independent) prior to the preparation of this specification. In the case of an independent connecting company, it is expected that such company will supply a suitable office code obtained by consultation with the Bell System.

1.622 (1.61) As covered in paragraph 1.21(k) of Part I of the General Specification, cases may arise where up to four different office codes may be required to be served by the common control switching entity covered by this specification. The need for this may arise as follows: (1) the office may serve different communities, where the rates for calls from distant points may be different; (2) it may be desired to use the same series of four-digit numbers for subscribers in different communities; (3) the office may serve communities in different states, or different numbering plan areas, where trunks from two or more toll centers may be provided; (4) there may be more than 10,000 subscribers in the office. If more than one office code is served, discrimination may be made either by a numbering plan arrangement or by separate trunk groups. Wherever possible, a numbering plan arrangement should be used, since it will be less expensive. Translation of the thousands digit may be used if it is not necessary to provide the same four-digit numbers for subscribers served by the different office codes, and ten thousand numbers are enough to serve all subscribers. Otherwise, where translating facilities are available in the connecting office, a directing digit may be added by the translator, preceding the numerical digits. Where neither of the preceding arrangements can be used, it will be necessary to provide separate trunk groups. In some cases, combinations of separate trunk groups and numbering plan or arbitrary code discrimination may be necessary. Such cases should be indicated in paragraph 1.61 of Part III of the specification, and a complete explanation given in paragraph 10.

1.623 As covered in paragraph 1.21(c) of Part I of the General Specification, the office will be equipped to handle the number of digits listed in that paragraph.

1.63 (Paragraph 1.62)

1.631 The office names and codes of all the offices which can be reached on an EAS basis by dialing seven digits should be listed.

1.64 (Paragraph 1.63)

1.641 The number of digits required to be received on incoming calls will normally be determined by the connecting office, although requirements for discrimination between terminating offices may be controlling, as outlined in paragraph 1.622 above.

1.65 (Paragraph 1.64)

1.651 The dialing procedures listed in paragraph 1.64 of [illegible] for Station Paid Toll, Person-to-Person, Special, [illegible] tion are the procedures recommended in the "Notes on Dist[illegible] The proper blanks should be checked to indicate whic[illegible] dures are to be used in this office. If any deviat[illegible]

recommended procedures are to be used, an explanation should be given in paragraph 10 of Part III.

1.652 The numbers to be dialed for wire chief, repair service, business office, etc., shall be indicated in paragraph 1.64. It is recommended that the following standard three-digit special service codes be used:

Service	Code
Repair Service	*611 or 7-Digit Number
Business Office	*811 or 7-Digit Number
Emergency	911
Time	844
Weather	936
Spare Codes	211,311,511, and 711

*The 611 and 811 codes are being phased out and should be used only when necessary to be uniform with a metropolitan or directory serving area.

The number translator will handle converting the three-digit number to a local line terminal where necessary.

1.653 The actual requirements for trunk circuit operation is covered in paragraph 4 of Part I of the specifications.

1.66 (Paragraph 1.65)

1.661 In most cases, assistance or special service calls will be handled by operators in the nearest toll center. The items should be filled in to indicate: whether these operators are in the same or a distant building; whether a separate group of operator trunks is to be provided or whether these calls are handled over the regular toll trunks or EAS trunks; the name of the distant office, if one is involved. If there is a special arrangement in the local office, it should be described here.

1.67 Interoffice Trunking Diagram (Paragraph 1.66)

1.671 (Paragraph 1.661)

An interoffice trunking diagram is a very useful aid when setting up requirements for an office, particularly one which is part of a network of offices. Such a diagram should be submitted with the specification. There are many possible variations of trunking plans, and it would be impossible to provide examples of trunking diagrams which would cover all cases. Two fairly simple diagrams are included herein to illustrate the type of information which should be shown.

1.672 Figure 1 shows a simple trunking diagram for a Class 5 office. It can be seen that EAS traffic to office Y is served by a high

usage group of eight direct trunks, with an alternate route via tandem office Z, using the same group of 25 trunks as is used for EAS traffic to office Z. Two groups of trunks are provided to office A, which serves as a Class 4 toll center. One group of 25 trunks handles the toll (and assistance) traffic, and one group of 15 trunks handles the EAS traffic to subscribers in office A.

1.673 Figure 2 is a trunking diagram for a Class 4 toll office, and does not show any trunking for EAS service. If such service should be required from this office, additional routes should be shown, as covered in Figure 1. A trunking diagram for a Class 4 office should indicate the class of each connecting office in the General Toll Switching Plan, and whether a group is "High Usage" or "Final." It should also show the office code of direct trunk points and the numbering plan area in which each is located. Where separate groups of incoming and outgoing one-way trunks are to be provided, this should be indicated. Quantities of trunks required should be indicated for each group.

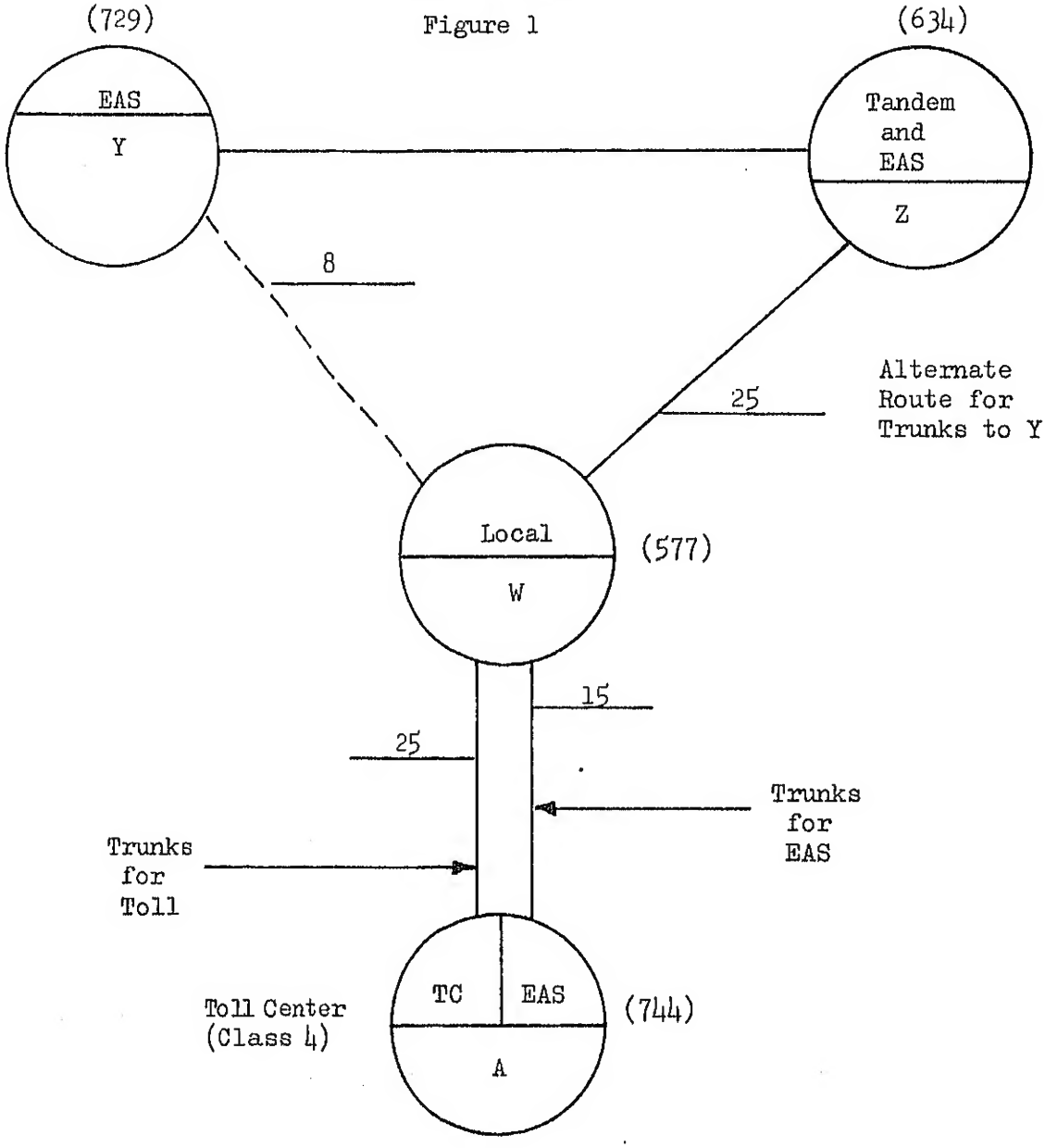
1.674 Common control central offices require the use of some type of translator to determine what routes are to be used, and what digits are to be outpulsed, for each number dialed. In all but the simplest cases, sufficient information cannot be obtained from the trunking diagram, and it will be necessary to include in the specification a translator function chart. This chart will be used by the Bidders to determine what cross-connections or memory programming should be provided in the translator. The function chart should show the called offices, whether they are EAS or DDD, the digits to be dialed by the subscriber, the required translator action in respect to deletion and prefixing of added digits, and the digits to be outpulsed by the sender. Alternate routes, if any, should be shown. Any codes which should be blocked should also be shown.

1.675 (Paragraph 1.662)

A translator function chart is included herein as an example. It shows the translator information required for the trunking diagrams shown in Figures 1 and 2. If there is any EAS traffic from the Class 4 office, translator information for handling such traffic would also be required. It should be noted that, since the numbering plan is not tied to the switching plan, it is not necessary to show local switch levels in the translator chart. The translator will cause the common control equipment to perform all necessary functions for selecting an outgoing trunk, without requiring any intraoffice pulsing by the sender. This makes the preparation of a translator function chart for a common control central office simpler than for a direct acting central office with adjunctive common control.

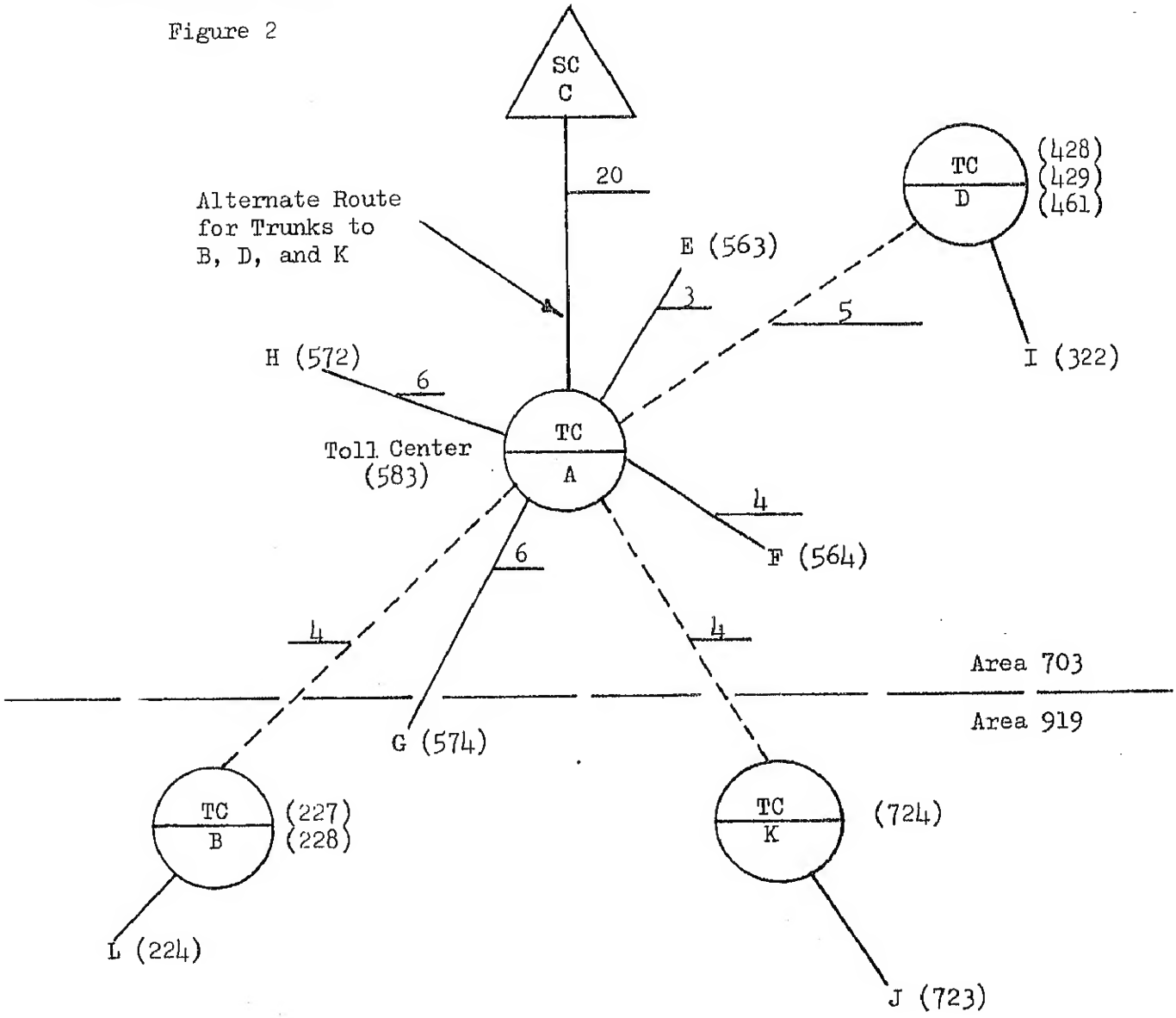
Class 5 Office
Trunking Diagram

Figure 1



W = Class 5 Office in Specification
Y = EAS Office
Z = Tandem and EAS Office
A = Toll Center and EAS Office
( ) = Office Code
_____ = Number of Trunks
_____ = Final Group
- - - - - - = High Usage Group

Figure 2



SC = Sectional Center
TC = Toll Center
A = Class 4 Office in Specification
G = Sectional Center
B, D, K = Other Toll Centers
E, F, G, H, I, J, L = Dial Tributaries
( ) = Office Code
_____ = Number of Trunks
_____ = Final Group
- - - - - = High Usage Group

Note: Unless otherwise specified, tributaries receive last 4 digits, toll centers receive 7 digits, and sectional center receives 7 or 10 digits.

Translator Function Chart

Figure 3

Called Point	Customer Dials	First Route: Translator Action Deletes	First Route: Translator Action Prefixes	First Route: Sender Sends	Alternate Route: Translator Action Deletes	Alternate Route: Translator Action Prefixes	Alternate Route: Sender Send
Class 5 Office (See Fig. 1)							
Local Office W	577-XXXX	--	--	*	--	--	--
EAS to Toll Center Subs.	744-XXXX	744	--	XXXX	--	--	--
EAS Office Y (Direct Trunks)	729-XXXX	729	--	XXXX	--	--	--
(Tandem Alternate Route)							
EAS Office Z	634-XXXX	634	7**	7-XXXX	72 --	-- --	9-XXXX --
DDD Office							
(Same Area)	1/0-NXX-XXXX	--	--	NXX-XXXX	--	--	--
(Other Areas)	1/0-NO/1X-NXX-XXXX	--	--	NO/1X-NXX-XXXX	--	--	--
Class 4 Office (See Fig. 2)							
Tributary E	1/0-563-XXXX	563	--	XXXX	--	--	--
Tributary F	1/0-564-XXXX	564	--	XXXX	--	--	--
Tributary G	1/0-919-574-XXXX	919-574	--	XXXX	--	--	--
Tributary H	1/0-572-XXXX	572	--	XXXX	--	--	--
Tributary I	1/0-322-XXXX	--	--	322-XXXX	--	--	322-XXXX
Tributary J	1/0-919-723-XXXX	919	--	723-XXXX	--	--	919-723-XXXX
Tributary L	1/0-919-224-XXXX	919	--	224-XXXX	--	--	919-224-XXXX
Toll Center A - Local Calls (See Above for EAS Offices)	-583-XXXX	--	--	*	--	--	--
Toll Center B	1/0-919-$^{227}_{228}$-XXXX	919	--	$^{227}_{228}$-XXXX	--	--	919-$^{227}_{228}$-XXXX
Toll Center D	1/0-428-XXXX			428-XXXX	--	--	428-XXXX
	429			429			429
	461			461			461
Toll Center K	1/0-919-724-XXXX	919	--	724-XXXX	--	--	919-724-XXXX
Other Dialable Points (Charge Calls)	1/0-7 Digits or Area Code + 7 Digits - As Above						

*Translator identifies 577 (or 583) as local office code and causes common control circuits to establish connection to XXXX.

**For selection at the tandem office, one, two, or three digits may be prefixed to XXXX, or office code may be sent as dialed.

X = Any Digit

N = Any Digit Except 0 or 1

2. LINE CIRCUIT REQUIREMENTS (Paragraph 2)

2.1 Types of Lines Required (Paragraph 2.1)

2.101 The data to be entered in paragraphs 2.101 to 2.113 represent the number and type of central office lines which will be required initially. The number of class of service marks required to indicate the different types of service which may be required for each type of line is to be determined by the supplier from this breakdown.

2.102 Determination of the numbers of subscribers' lines of each type which will be required should be based on the number of subscribers in the various categories, and the assumed "line fills" (average number of parties served from one line). The estimated total number of establishments in the five-year forecast (REA Form 569) shall be used in preparing this information.

2.103 It is anticipated that for both buried and aerial plant approximately an 80 percent line fill will be achieved for all multiparty grades of service by the end of the five-year period. On this basis, the following party line fills should be assumed:

Type of Line	Main Stations Per Line
Two-Party	1.6
Four-Party	3.2

2.104 The subscriber data for the five-year period, by types of line, should be entered in column (b) of paragraph 2.31. Care should be exercised in this connection to ensure the separation between business and residence subscribers, since the unit calls may be different for these two types of service.

2.105 Utilizing the line fills and the subscriber data discussed above the number of lines should be determined for each grade of service, maintaining the separation between business and residence service wherever applicable. The number of lines, in every case, should be rounded off to the next highest whole number.

2.106 (Paragraph 2.112)

The "total number of lines required" to be entered in paragraph 2.112 should be determined as in the following examples:

2.1061 Assume that the number of residence one-party main stations is 730, and that the number of business one-party main stations is 90.

2.1062 (Paragraphs 2.101 and 2.102)

Since, for one-party lines, the total number of lines is equal to the number of main stations required, the total number of lines to be entered in paragraphs 2.101 and 2.102 will be the sum of the one-party main stations; that is, 730 plus 90, or 820 lines. If message rate service is not provided, 820 should be entered in paragraph 2.101 under "Total Number of Lines Required." If message rate service is required, this number of lines (820) should be allocated between flat rate and message rate as described in paragraph 2.107 below.

2.1063 Assume that the number of residence two-party main stations is 60.

2.1064 Assume that the number of business two-party main stations is 12.

2.1065 The number of residence two-party lines will be 60 divided by 1.6, or 37.5 lines. This will mean a total of 38 residence two-party lines.

2.1066 The number of business two-party lines will be 12 divided by 1.6, or 7.5 lines. This will mean a total of eight business two-party lines.

2.1067 (Paragraphs 2.103 and 2.104)

The total number of lines to be entered in paragraphs 2.103 and 2.104 will be the sum of the two-party lines; that is, eight lines plus 38 lines, or 46 lines. This number of lines shall be allocated between flat rate and message rate as covered in paragraph 2.107.

2.107 (Paragraphs 2.102 and 2.104)

If message rate service (described in paragraph 5.306 below) is desired on some individual or two-party lines, the total lines required for such service should be indicated in paragraphs 2.102 and 2.104, with the remaining number of lines required indicated in paragraphs 2.101 and 2.103, respectively. It is necessary to break down line quantities between flat rate and message rate service, because a separate class mark is required for each class of service to ensure connection to the proper type of trunk, or to ensure recording of all calls from the message rate line (see paragraph 2.101 above).

2.108 When EAS service is provided, different rates may be offered for local (home office only) and EAS service. Also, more than one type of EAS service may be offered, with different rates for each EAS service offering. The proper numbers of lines shall be entered in the "Local Service Only" and the "Both Local and EAS Service"

columns for each type of line. The totals of these two columns shall equal the totals in the "Total Number of Lines Required" column. The number of EAS areas shall be entered in the "Number of EAS Areas" column.

2.109 (Paragraphs 2.107 and 2.108)

The number of "official lines" should be entered for each exchange involved. Any lines not included in the Area Coverage Design, such as business office line(s), manager's line, repairman's line, remote test circuits, etc., shall be entered under paragraph 2.107. One line shall be shown for wire chief, in paragraph 2.108.

2.110 The various sizes of number hunting and non-Centrex PBX trunk groups shall be entered in paragraph 2.109 under the column headed "Number of Lines in Group." The number of groups of each size shall be entered in the column headed "Number of Groups." The number of groups of each size which require restricted service shall be entered in the column headed "Restricted Service at COE."

2.111 Thought should be given to the possible requirements for number hunting service or key service for non-PBX customers. Business establishments not large enough to require a PBX can make good use of this type of service. As the use of single-party service increases, it is probable that the use of number hunting service will also increase. Paragraph 6.221 of Part I of the specification states that equipment shall be provided for at least one trunk hunting line group in each 100 SDN's equipped, and that more may be provided as specified by the owner. However, this has nothing to do with the line equipments required, as the trunk hunting arrangements are a part of the common control equipment. Accordingly, if the office has no immediate requirements for number hunting groups it will not be necessary to include any reserve line quantities for this purpose in the column headed "Total Number of Lines Required."

2.112 Subscribers served by extensions in non-Centrex PBX's may have restricted service, either on a local or a toll basis. PBX extensions to be denied direct dial local service will be screened by the PBX equipment and routed to the PBX attendant. In this case, nothing is involved in the central office circuitry. Hence, nothing need be entered in the "Restricted Service" column for such PBX's. Also, nothing need be entered in that column for number hunting groups.

2.113 When subscribers served by extensions in non-Centrex dial PBX's are permitted to dial local and/or EAS numbers, but are to be denied toll service, the central office equipment must be arranged to send a signal to such PBX's when a toll number is dialed. This is most commonly accomplished in the trunk circuit reached when dialing is completed. To insure that the bidder will provide this feature, a check mark should be placed in the "Restricted Service at COE" column for such PBX's.

2.114 (Paragraph 2.110)

When Centrex PBX groups are to be served, the PBX extensions may appear as lines on the central office switching network. Quantities of such extensions for all Centrex PBX groups shall be entered under the heading "Extensions." Quantities of lines used for completing calls to and from Centrex PBX attendants, and to and from remote Centrex switching units, shall be totaled and entered under "Trunks."

2.115 When Centrex PBX extensions are served by the central office switching network, and some extensions are to be denied local service, it will be necessary to have a separate class mark for such extensions for each Centrex PBX having this feature. This should be indicated under "Restricted Service - Local" by a check mark. If more than one Centrex PBX is required, different arrangements may be required for different PBX's. This should be explained in paragraph 10, Part III of the specification.

2.116 When Centrex PBX's are to be served, and some extensions are to be provided local and EAS out-dialing, but denied toll service, and others permitted to make toll calls on an identified outward dialing basis, this should be indicated by a check mark under "Restricted Service - Toll." If more than one Centrex PBX is required, different arrangements may be required for different PBX's. This should be explained in paragraph 10, Part III of the specification.

2.117 (Paragraph 2.111)

When WATS lines are to be served, some lines may require access to different zones or combinations of zones. Each such different zone or combination will require a separate class mark, so the total number of WATS lines and zones shall be entered for paragraph 2.111. Details of WATS lines other than this should be covered in paragraph 10, Part III.

2.118 (Paragraph 2.112)

The total to be entered is self-explanatory. Since different suppliers provide line equipments in different increments, the total number of line equipments to be provided cannot be determined by the owner. This figure will be provided in Part IV of the selected Bidder.

2.119 In determining the quantities of line equipments to be provided, Bidder will take into consideration the line equipments
[illegible]s system for test purposes, as specified in paragraph
[illegible] of the specification, and any future requirements for
[illegible] appearances which may be specified in notes in
[illegible]art III.

2.120 (Paragraph 2.113)

If there are existing groups of subscriber directory numbers that are to be retained, this information should be covered in paragraph 10 and a note to that effect put here.

2.2 Data on Lines Requiring Range Extension (Paragraph 2.2)

2.21 (Paragraph 2.21)

2.211 Equipment purchased under the Common Control Central Office Equipment Specification is capable of serving non-pay station subscriber lines with loop resistances, including the telephone set, up to and including 1900 ohms, under stabilized voltage conditions. If there are any lines with a loop resistance greater than 1900 ohms, the number of such lines should be indicated in the appropriate loop range space provided in this paragraph. It is assumed that the resistance of a telephone set is 200 ohms on all loops. See paragraphs 3.11 and 3.12, Part I, and 3.1, Part I, Appendix A of the specification.

2.212 Several methods are now available, from different suppliers, for providing range extension for lines exceeding 1900 ohm loop resistance.

2.2121 Long line adapters were the conventional circuits for this purpose. They contain standard central office switching components and pulse correction and are included with the central office equipment as shown in the "List of Materials Acceptable for Use on Telephone Systems of REA Borrowers," REA Bulletin 344-2. Long line adapters had to be connected to a +48-volt booster power supply.

2.2122 The conventional devices for central office equipment range extension are loop extenders which are available from a number of manufacturers. These devices, which use largely solid state components, incorporate their own power supply, and are less expensive than long line adapters. They do not provide any pulse correction, however. An REA "Specification for Central Office Loop Extenders," PE-61, is issued to establish requirements for these devices, and those which are acceptable are listed in REA Bulletin 344-2.

2.2123 While the methods of providing range extension listed above will provide satisfactory supervisory, dialing, and ringing performance, none of them provides transmission gain. Accordingly, voice frequency repeaters may be needed to provide acceptable voice transmission. Refer to REA TE&CM 424, "Design of Two-Wire Subscriber Loop Plant."

2.22 (Paragraph 2.22)

2.221 The number of pay station lines with outside plant loop limits, excluding the pay station, greater than 1200 ohms (for prepay or local prepay) or 1000 ohms (for semi-postpay operation), should be indicated. A discussion of the factors involved is provided in REA TE&CM 703, "Pay Station Services."

2.23 (Paragraph 2.23)

2.231 (Paragraphs 2.231 and 2.232)

Ordinarily, the Bidder will be requested by the Owner to provide equipment to guarantee proper operation with all lines in the office. Cases may arise, however, where the Owner wishes to provide range extension equipment (loop extenders and voice frequency repeaters) himself, either to reuse equipment from other offices or to have his own say as to the type of equipment to be used. If all equipment is to be provided by either the Owner or Bidder, the appropriate quantity and block should be checked. If some equipment is to be provided by the Bidder, and some by the Owner, both blanks should be checked and the quantity division shown. A Bidder will not be responsible for operation of its equipment with range extension equipment provided by the Owner, but will be expected to advise the Owner, on request, as to whether or not the central office equipment will function properly with what the Owner provides. The Owner should specify manufacturer and part number of equipment being supplied in a note in paragraph 10 of Part III.

2.232 (Paragraph 2.333)

It is distinctly feasible to provide circuitry in a common control switching system for switched-in range extension circuits to realize the savings which can be obtained by concentration. The savings possible for a specific office by the use of such an arrangement should be investigated by the borrower or its engineer if an appreciable number of lines over 1900 ohms loop resistance is required. Where voice frequency repeaters are required, they may also be provided on a switched-in basis. If these features appear advantageous, they should be permitted in paragraph 2.233 and details given in paragraph 10, Part III. REA TE&CM 429, "Design of Two-Wire Subscriber Loop Plant - Common Mode Operation," provides information on repeater gains which can be used in this application.

ragraph 2.24)

semi-postpay, prepay or prepay dial
ified here. The type selected must
g company and in some cases may be
See TE&CM 703, "Pay Station Services."

2.25 (Paragraph 2.25)

From a traffic standpoint, 100 percent lockout is recommended in all cases, but some systems that the engineer may wish to include in the bidding may not have it. This should be taken into consideration.

2.3 Traffic Data

2.31 (Paragraph 2.31)

2.311 This paragraph is used to calculate the overall originating busy hour traffic for the office, and also the number of lines required, using the number of main stations for the five-year period. In the case of types of lines not anticipated in the Area Coverage Design, such as Centrex, WATS, and Data Service, an estimate should be made for the purposes of the specification, to insure that provisions will be made for all types of service which might be required by the end of the five-year period.

2.312 As pointed out in paragraph 1.15 above, traffic data as to CCS per main station (CCS/MS) contained in the Area Coverage Design is likely to be obsolete, so it is extremely desirable that current data be obtained from actual traffic measurements with projection for effects of upgrading, if applicable. If such measurements cannot be made, an attempt should be made to obtain data from similar exchange areas in the vicinity. If this cannot be done, it is recommended to use the following calling rates to fill the first column in paragraph 2.31:

Class of Service	CCS per MS
Individual - Residence	1.2
Individual - Business	1.8
Two-Party - Residence	1.0
Two-Party - Business	1.5
Four-Party	0.7
Pay Stations	1.8
PBX Lines	4.0
Telephone Company Official	2.0
Wire Chief	1.2

2.313 When an office contains a large number of interoffice trunks, the interoffice trunk traffic, as shown in paragraph 3.11, Part III, should be compared with the total originating traffic to make sure the unit station calling rate is high enough. This is especially true if there are EAS trunks.

2.32 (Paragraph 2.32)

2.321 If the computed originating busy hour CCS per line, using the data from paragraph 2.31, Part III, comes to less than 1.7 CCS/L for offices with four-party service, the office should be engineered to handle 1.7 CCS/L. It is recommended that a minimum of 1.3 CCS/L for single-party systems and 1.6 CCS/L for one- and two-party systems be used to insure adequate traffic handling capacity for these systems. REA believes these figures are the minimum which may be used to insure that adequate traffic carrying capacity will be provided. The 5-year and ultimate traffic figures must show a realistic change based on local experience. These figures could have a direct bearing on the type of equipment proposed.

2.33 (Paragraph 2.33)

2.331 If it is necessary to increase the originating BH CCS/L to obtain the values as described above, then the terminating BH CCS/L should be increased in the same proportion. In rural offices, the assumption is usually made that the originating and terminating traffic are equal, but this is not always the case. In resort areas, for instance, the originating traffic is usually larger than the terminating traffic. However, unless otherwise specified, the terminating traffic is assumed to be equal to the originating traffic.

2.34 (Paragraph 2.34)

2.341 In some cases, where only a small proportion of the total number of lines required is needed for PBX and number hunting lines, the Bidder may wish to engineer the switching network in such a manner that PBX and number hunting lines will be segregated in certain switch groups. In such cases, it shall be the responsibility of the Bidder, using the information provided in paragraph 2.31, Part III, to calculate the traffic for the various switch groups so as to achieve the desired grade of service. A system in which PBX's are equally distributed over line groups is preferable to segregating them in special groups.

2.35 (Paragraph 2.35)

The percentage of the total number of subscriber lines that will be set up to receive tone dialing is to be shown here. If 100 percent is to be the figure, be certain that all subscribers will accept it as there can very possibly be a lower number of local registers supplied than when a percentage of the subscribers have rotary dial. See paragraph 11.231, Part I, of Form 524.

2.36 (Paragraph 2.36)

2.361 (Paragraph 2.361)

The ultimate number of lines should be estimated. In the absence of detailed information, and provided the present population trend is not downward, an ultimate capacity of two to

two and a half times the initial number of subscribers may reasonably be assumed. It may also be assumed that the service will become totally one-party within five years.

2.362 Since manufacturers make different types of equipment, large ultimate size (LUS) and small ultimate size (SUS), for different size offices, the number of lines specified in paragraph 2.361 will determine the type of equipment to provide initially so that future growth may be handled. The systems which have a maximum growth of 6000 lines or less are SUS and systems which have a capacity beyond 6000 lines are designated LUS. For small systems there has been an appreciable saving in purchasing the SUS equipment.

2.363 Very careful consideration should be given to each situation, since an error in judgment in this respect might prove very costly. In particular, every attempt should be made to anticipate types of lines which may be required in the future, although not provided initially, such as Centrex extensions, WATS lines, and Data Service lines.

2.364 (Paragraph 2.362)

The ultimate number of subscriber directory numbers required usually may be determined by assuming that the service will become totally one-party within five years, increasing the number of lines required by 10 percent, and then bringing this figure up to the next even thousand.

2.365 The figures given in paragraphs 2.361 and 2.362, Part III, indicate only what is required by the Owner. These figures will be used by the Bidders to determine the ultimate number of line relay equipments, line terminals on the switching network, and subscriber directory numbers in the number group circuits (or equivalent) which should actually be provided for.

3. TRUNK CIRCUIT REQUIREMENTS

3.1 Interoffice Trunks (Paragraph 3.1)

3.11 (Paragraph 3.11)

3.111 General. Also see Paragraph 4, Part I.

3.1111 A considerable portion of the information necessary to complete the Trunking Requirements form can be obtained from a completely and properly executed REA Form 810, "Central Office Equipment Engineering Information," for the borrower's exchange. A completed REA Form 810 must be prepared for each exchange before attempting to complete the Trunking Requirements form. The REA Form 810 should be included for information purposes with the specification sent to suppliers for bids.

3.112 Line 1: This is to be completed with the geographical name of the distant office. Each column will be used for a separate trunk group even though they go to the same office.

Line 2: Complete with the type of service for which the trunk will be used, i.e., Operator, Extended Area Service, Busy Verification, CAMA, PPCS, Pay Stations, etc.

Line 3: The quantity of trunks in many cases will be dictated by the agreement between the borrower and the connecting company. Otherwise, the number of trunks will be dictated by the CCS capacity as shown in the fifth line.

Line 4: The percent of the original number of trunks which can be reasonably expected to be added to the group. Without additional information the same percentage growth may be shown as is given for subscriber lines.

Line 5: Traffic loads in CCS/BH for interoffice trunk groups shall be listed in the appropriate blanks of line 5, paragraph 3.11. This information, if not available, can be estimated for the purpose of calculating the switch quantities from the trunk quantities at B.005, using the Erlang Table.

a. Midpoint Traffic Capacity

In deriving the traffic capacity of the trunk groups from their quantities, the midpoint capacity shall be used. For example, the midpoint traffic capacity of 18 toll connecting trunks at B.005 is 332 CCS $\left(\frac{318 + 345}{2} = 332\right)$.

b. Traffic Capacity of Partial Two-Way Trunk Groups

The traffic capacity of partial two-way trunks shall be estimated as shown in the following example:

Example: An EAS route consists of 15 one-way outgoing trunks, 20 one-way incoming trunks and five two-way last choice trunks. What is the traffic capacity of the combined group?

The traffic capacity in each direction shall be estimated as the traffic capacity of the one-way trunks plus the portion of the two-way trunks divided between outgoing and incoming in proportion to their quantities. In this example, the five two-way trunks are divided between outgoing and incoming as follows:

Proportion of Two-Way Trunks for Outgoing Traffic $= \frac{5 \times 15}{20 + 15} = 2.1$

Proportion of Two-Way Trunks for Incoming Traffic $= \frac{5 \times 20}{20 + 15} = 2.9$

The outgoing traffic will use two trunks of the two-way group and the incoming traffic will use three trunks. Midpoint traffic capacity of 15 + 2 = 17 trunks for outgoing traffic = 305 CCS and the midpoint traffic capacity of 20 + 3 = 23 trunks for incoming traffic is 469 CCS. When a mixed group is encountered, put the word "combined" in the CCS for two-way trunks and put calculated CCS under one-way trunks for both in and out directions.

c. High-Usage Groups

High-usage (HU), intertoll or interlocal groups are designated as follows: "10 HU 12", signifying 10 HU trunks in which the last incremental trunk carries 12 CCS (called the Economic CCS). Since the use of HU trunks in offices of REA borrowers is rare and since the economic CCS is not usually specified (although 12 CCS is usually used for short haul trunks), the traffic capacity of high-usage trunks can be estimated from the Erlang Table. The present procedure is set forth to make a conservative estimate of the traffic capacity of high-usage groups by using the Erlang Table.

It should be mentioned that we are not setting a new procedure for estimating the quantity of trunks in high-usage routes which is the function of the Connecting Company, but rather a simple procedure for estimating the busy hour calls required to determine the quantities of the common control units. The difference in the estimate of the traffic capacity from the AT & T Tables and the Erlang Table can be illustrated by comparing, for example, the capacity of 10 HU 12.

(1) From the AT & T Tables:

The offered and carried traffic of 10 HU trunks whose last incremental trunk carries 12 CCS is as follows:

Offered CCS	Carried CCS	Overflow CCS
256	235	21
258	236	22
260	237	23
262	238	24
264	239	25
266	241	25

(2) From the Erlang Table:

The traffic offered to 10 trunks at B.10 is 270 CCS. The meaning of B.10 is that the blocking probability is 10 percent, or in other words, 10 percent of the traffic will overflow to the alternate route. Therefore, the overflow traffic = 270 x 0.10 = 27 CCS and the traffic carried by the high-usage group = 270 - 27 = 243 CCS as compared to the range from 235 to 241 CCS obtained under (1) above. If this HU group serves an incoming toll completing group, we will be interested in the traffic carried (243 CCS) which is received at the terminating office in which we are concerned, but on the other hand, if the HU group serves an outgoing route, we will be interested in the total offered traffic (270 CCS) which will be served by the common control equipment. We are not concerned, however, by the portion of overflow traffic which the connecting company includes in the trunk estimate of the alternate route.

d. Final Groups

Final groups are usually engineered so that an incremental intertoll trunk carries 30 CCS and an incremental interlocal trunk carries 28 CCS. These values correspond to large final groups consisting of over 20 trunks. Since final routes used in offices of REA borrowers will be small and since they carry peaked traffic which requires more circuits than random traffic, a conservative estimate of the traffic capacity of final routes will be that shown in the Erlang Table at B.005. The midpoint traffic capacity of a final group consisting of 15 trunks will be 253 CCS.

Line 6: This line is to be completed with the information as to the direction of the trunks relative to the office being specified. In the rare case of groups which have one- and two-way trunks combined, see paragraph 3.112, line 5,b of this document.

Line 7: Enter the total number of digits dialed by a subscriber to complete calls over this trunk group. For instance, if it is a CAMA group dialing "1" plus 7/10 digits, write 8/11. On an EAS group, signify 7 even though a translator might add more digits for a tandem situation.

Line 8: The number of digits to be outpulsed, from the office covered in the specification, to complete calls in the distant office is to be inserted in this line. This information will be used to determine the average holding times of the originating register senders.

Line 9: To be completed with the number of digits to be received by this office on incoming trunk calls to local and/or tandem calls. This information will be used to determine the average holding times of incoming registers.

Line 10: Type signaling refers to whether it will be E & M, loop dial, tone, etc.

Line 11: Type pulsing refers to the mode by which the digital address information is sent. Examples are 20 pulses per second, 10 pulses per second, multifrequency dialing.

Line 12: Check if trunks are to be carrier derived. If the group is partially carrier derived, place a number corresponding to the number of carrier channels in the group.

Line 13: Check if trunks are to be on physical circuits. If the group is partially physical, place a corresponding number here. This should agree with line 3 and line 12.

Line 14: Complete with number of repeat coils for physical circuits only.

Line 15: When E & M signaling is specified on physical trunks, "DX" shall be provided in preference to the CX or SX type except where required for compatibility with a connecting office. Accordingly, the CX and SX types of signaling are not listed under trunking requirements. If such circuits are required for compatibility, a check should be made in line 16, "Other Type Signaling," and the type and quantity of circuit required shall be specified by a note in paragraph 10, Part III. Specify the number of DX circuits on this line.

Line 16: In the absence of DX signaling, the most preferable signaling on physical trunks is loop dial. If to be specified, it should be done here.

a. The principal application for loop dialing is on one-way voice frequency trunk groups. The normal loop pulsing has a relay at one end of the trunks connected to positive and negative potentials, and operated by opening and closing a loop path at the other end. Battery-ground pulsing uses two windings at each end of the trunk, connected together with positive and negative potentials in series aiding. This effectively doubles the current in the loop. Standard loop dial trunks will operate satisfactorily over circuits up to 1200 ohms loop resistance while carrier derived loop dial trunks are limited in length only by carrier transmission considerations from carrier terminal to carrier terminal. (Trunks arranged for battery-ground pulsing will function satisfactorily above 1200 ohms loop resistance on special applications.) Before specifying either option the connecting company should be consulted. In such cases it important that the connecting company circuit drawing [illegible] end of the trunks be made available to the Bidders. trunks are to be provided, it should be specified and ground or the loop pulsing type of circuit is

derived trunks are coming into increasing use where the loop signaling circuit is included as part of the carrier equipment. This eliminates the need for separate trunk circuits in direct acting central offices, but the conditions affecting the use of such circuits in common control offices are complex, and are discussed in paragraphs d, e, and f below.

b. Where satisfactory operation cannot be provided with loop signaling circuits, DX signaling shall be used, if it will meet the loop resistance requirements, and the outside plant consists entirely of cable. Otherwise, it will probably be necessary to provide for carrier operation, unless the SX or CX operation is required for compatibility with the connecting office. DX signaling can operate without impairment through E type repeaters, or the equivalent, and is much less subject to noise induction than SX or CX signaling. DX operation requires a trunk circuit with E and M lead signaling. A trunk circuit arranged for E and M lead signaling (polar duplex operation) can be used over DX, SX, CX, or carrier facilities.

c. Many suppliers have arranged their carrier or radio derived trunk circuits to incorporate loop signaling to and from direct acting central office equipment. In such offices, then, no separate outgoing trunk repeater circuit or incoming trunk relay equipment will be required.

d. Most common control switching systems are arranged to connect senders into outgoing trunks, by the use of sender links, to outpulse the called number information, while holding the connection from the calling subscriber and providing transmitter current. In such systems the provision of loop signaling carrier trunks does not eliminate the need for an outgoing trunk circuit of the type which would normally be provided anyway for loop signaling voice frequency trunks. However, a combination of an outgoing trunk circuit arranged for E and M lead signaling with a carrier derived trunk terminating circuit arranged for E and M lead signaling is normally less expensive and provides less transmission loss than a combination of a loop signaling outgoing trunk circuit and a loop signaling carrier derived trunk terminating circuit. This is true even though loop pulsing from the outgoing sender must be converted into E and M lead pulsing in the outgoing trunk circuit. Accordingly, unless some compelling reason exists for using loop signaling carrier derived trunk terminating circuits, the trunk terminating circuits arranged for E and M lead signaling should be specified for the type of common control offices discussed in this paragraph. If for some reason loop signaling outgoing trunks and loop signaling carrier derived trunk terminating circuits must be used, it is essential that the trunk terminating equipment be arranged to return reverse battery supervision to the calling end of the connection, to activate stop dialing and wink signaling features in the outgoing sender if connected to common control equipment. The additional transmission loss introduced by the added outgoing trunk supervisory arrangements should be taken into consideration in establishing the overall net loss.

e. Some common control systems connect senders through the regular switching network to the outgoing trunk, and substitute a transmission and supervisory circuit after outpulsing is completed. In simple systems of this type it may not be necessary to use a separate loop signaling trunk circuit between the switching network and a carrier derived trunk terminating circuit arranged for loop signaling, provided that the latter circuit is arranged to provide all the switching features required by the common control system for establishing and holding connections. However, in most cases a separate outgoing trunk circuit will be necessary to provide switching and supervisory features not available in the carrier derived trunk terminating equipment. In this case, the use of outgoing trunk circuits and carrier derived trunk terminating circuits arranged for E and M lead signaling is recommended. The Owner will determine from the nature of the overall switching requirements, for an office of the type discussed in this paragraph, whether or not an additional outgoing trunk relay equipment is required.

f. For terminating calls over carrier derived trunk terminating circuits, it will always be necessary to provide a relay type incoming trunk circuit between the carrier equipment and the switching network to provide means for associating the trunk with an incoming register by way of a link circuit. E and M lead signaling from the carrier derived trunk terminating circuit is preferred in this case, together with an incoming trunk circuit arranged for E and M lead signaling. If loop signaling is provided from the carrier circuit for some reason, the incoming trunk circuit will introduce an additional transmission loss.

g. Paragraph 4.312, Part I of the specification states that idle circuit terminations shall be provided on interoffice trunks and that the trunks shall remain in a terminated condition until seized. It is the purpose of this requirement to maintain the trunk in a terminated condition to prevent singing or other undesirable effects when carrier or multiplex equipment is provided. The loop dial type of carrier equipment has a built-in arrangement to open the transmission path when in the idle condition.

Line 17: If the trunk is coming from a distant office which has a sender, then it should be assigned as delay dial. The purpose of this is to stop the distant sender until a local incoming register has been attached to the trunk. The incoming registers can be supplied at a lower grade of service under these conditions. If the distant office is direct driven step-by-step then the dialing cannot be delayed and registers must be provided in larger quantity.

3.1112 Additional lines are left for requirements of the trunk or trunk group which are not listed in lines 1 - 17. If there are special signals such as wink start or unusual conditions at the far end which must be met, they are to be listed here.

3.2 Trunk Traffic (Paragraph 3.2)

3.21 The traffic data normally used in the past for engineering central offices has been expressed in terms of CCS only. For determining the quantities of common control equipment, it is necessary to have information as to the actual number of calls made during the busy hour. If the average call holding time is known, per type of call, the number of busy hour calls can be calculated by dividing the busy hour CCS figure times 100 by the call holding time in seconds. Even if data is given in the Area Coverage Design as to the total number of originating busy hour calls per main station (BHC/MS), by type, such data is likely to be obsolete. It is highly desirable that current data be obtained from actual traffic measurements. If such measurements cannot be made, the call holding times in paragraph 11.31 of Form 524, Part I, shall be used in figuring out the busy hour calls required for estimating the quantities of common control units. These holding times are conservative and represent the average effective and ineffective calls.

3.22 It should be emphasized that some of the newer services such as Data Service may have extremely short holding times, so that for the same CCS/BH, the BHC/MS for such lines may be much higher than for regular subscriber lines.

3.23 The busy hour calls for assistance, special service, EAS and toll shall be calculated by applying the appropriate holding time to the CCS/BH data provided for the various outgoing and two-way trunk groups, as listed in paragraph 3.2, Part III. The breakdown between station-to-station (Prefix "1") and PPCS (Prefix "0") traffic shall be estimated by the Owner if not available from current traffic measurements. In the absence of measured data, the toll busy hour CCS shall be broken down between S-S and PPCS in the ratio of 4:1. The PPCS busy hour CCS shall be broken down between "0-" and "0+" digits in the ratio of 1:4, and the DDD busy hour CCS shall be broken down between 7 and 10 digits in the ratio of 2:1.

3.24 Office Busy Hour Versus Group Busy Hour

It is well known that due to non-coincidence of group busy hours of the trunk groups, the office busy hour load, that is, the load of the various groups at the same busy hour, will be less than the sum of the group busy hour loads. However, the reduction of the group busy hour load will not be made in any part of the switch calculation. The larger load guarantees more generous grade of service.

3.3 Originating Traffic (Paragraph 3.21)

3.31 The intraoffice traffic should be provided by the Owner or its engineer, but in the absence of such information the IAO and O- traffic can be estimated from the subscribers' originating calling rates and the trunk quantities using the following assumptions:

a. The subscribers' originating and terminating traffic are equal.

b. Where two-way trunks are provided, the originating and terminating EAS traffic are equal.

c. The originating intraoffice traffic equals the difference between the total subscribers' originating traffic and the outgoing traffic.

Since the amount of intraoffice traffic calculated in this manner tends to be underestimated, it will be assumed that the intraoffice traffic shall not be less than 40 percent of the originating traffic in order to assure provision of sufficient intraoffice trunks.

d. The operator assistance traffic equals one half the difference between the CCS capacity of the two-way toll connecting trunks and the CAMA trunks.

e. In case of TSPS operation in which "O+", "O-" are combined in one route, the operator assistance traffic (O-) can be estimated as 20 percent of the total TSPS traffic, unless specific data is available.

f. Busy Hour Attempts are the number of busy hour calls increased by a factor of 20 percent to allow for false register seizures when dialing is not completed or busys are encountered. The local originating registers must be proportioned to include this traffic. The figure 20 percent is used in the absence of true information.

3.32 (Paragraph 3.22)

The Owner or his engineer shall estimate the percentage of originating traffic, by types, which will be completed locally, and apply this percentage to the CCS/BH figures shown in the "Total CCS" column of paragraph 2.31, Part III. In case intraoffice traffic is not given, it can be estimated as shown in paragraph 3.31 of this section.

3.33 In most cases, only two types of intraoffice trunks need be provided - pay station and non-pay station. In this case, the intraoffice CCS/BH figures may be divided in proportion of their originating traffic, reference paragraph 2.31, Part III, and these

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3.22 It should be emphasized that some of the newer services such as Data Service may have extremely short holding times, so that for the same CCS/BH, the BHC/MS for such lines may be much higher than for regular subscriber lines.

3.23 The busy hour calls for assistance, special service, EAS and toll shall be calculated by applying the appropriate holding time to the CCS/BH data provided for the various outgoing and two-way trunk groups, as listed in paragraph 3.2, Part III. The breakdown between station-to-station (Prefix "1") and PPCS (Prefix "0") traffic shall be estimated by the Owner if not available from current traffic measurements. In the absence of measured data, the toll busy hour CCS shall be broken down between S-S and PPCS in the ratio of 4:1. The PPCS busy hour CCS shall be broken down between "0-" and "0+" digits in the ratio of 1:4, and the DDD busy hour CCS shall be broken down between 7 and 10 digits in the ratio of 2:1.

3.24 Office Busy Hour Versus Group Busy Hour

It is well known that due to non-coincidence of group busy hours of the trunk groups, the office busy hour load, that is, the load of the various groups at the same busy hour, will be less than the sum of the group busy hour loads. However, the on of the group busy hour load will not be made in any part switch calculation. The larger load guarantees more generous f service.

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a. The subscribers' originating and terminating traffic are equal.

b. Where two-way trunks are provided, the originating and terminating EAS traffic are equal.

c. The originating intraoffice traffic equals the difference between the total subscribers' originating traffic and the outgoing traffic.

Since the amount of intraoffice traffic calculated in this manner tends to be underestimated, it will be assumed that the intraoffice traffic shall not be less than 40 percent of the originating traffic in order to assure provision of sufficient intraoffice trunks.

d. The operator assistance traffic equals one half the difference between the CCS capacity of the two-way toll connecting trunks and the CAMA trunks.

e. In case of TSPS operation in which "O+", "O-" are combined in one route, the operator assistance traffic (O-) can be estimated as 20 percent of the total TSPS traffic, unless specific data is available.

f. Busy Hour Attempts are the number of busy hour calls increased by a factor of 20 percent to allow for false register seizures when dialing is not completed or busys are encountered. The local originating registers must be proportioned to include this traffic. The figure 20 percent is used in the absence of true information.

3.32 (Paragraph 3.22)

The Owner or his engineer shall estimate the percentage of originating traffic, by types, which will be completed locally, and apply this percentage to the CCS/BH figures shown in the "Total CCS" column of paragraph 2.31, Part III. In case intraoffice traffic is not given, it can be estimated as shown in paragraph 3.31 of this section.

3.33 In most cases, only two types of intraoffice trunks need be provided - pay station and non-pay station. In this case, the intraoffice CCS/BH figures may be divided in proportion of their originating traffic, reference paragraph 2.31, Part III, and these

figures should be entered in the first two blanks of paragraph 3.22. However, if there is a need for separate groups of intraoffice trunks for other purposes, such as segregating flat rate and message rate traffic, or providing for data services through special types of trunks, this information should be given in paragraph 10, Part III, and a check mark placed in the third blank of paragraph 3.22.

3.4 Terminating Traffic (Paragraph 3.3)

3.41 The data provided in paragraph 3.3, Part III, will be used by the Bidder in determining the quantities of incoming registers or equivalent circuits required. The number of terminating calls of various types may be obtained as described for originating calls in paragraph 3.31 above. The CCS/BH figures given in paragraph 3.11 of Part III may be used with the HT/BHC used for DDD and EAS calls, and for local incoming and intraoffice calls, in obtaining the overall number of terminating calls. Intraoffice call traffic will not be utilized in calculating incoming register quantities except in the case of systems using incoming registers or the equivalent in the process of completing intraoffice calls. The same will hold for toll switch calls where the incoming toll from a distant office is automatically switched through to the connecting company's toll trunks without dialing.

3.42 Tandem Traffic

It is necessary to indicate the volume of tandem EAS traffic, if any. Since the usual method of calculating the intraoffice traffic requires a knowledge of the tandem traffic, the most practical method is to measure equivalent of the tandem traffic as it exists in the present system. If data is not available, the tandem EAS traffic can be approximated from the trunk quantities, provided the intraoffice traffic is known from another source, as explained in the following example:

		CCS
Given:	Subscriber's Originating Traffic =	3050
	Intraoffice Traffic =	1230
	Outgoing Traffic, Non EAS: (Operator Assistance + CAMA + Special Service) =	245
	Total Outgoing EAS, Including Tandem =	1800
	EAS Traffic Originated by Subscribers = 3050 - (1230 + 245) =	1575
	EAS Tandem = 1800 - 1575 =	225

See Appendix for method of obtaining the necessary information using an imaginary office. Shown are suggested work sheets for completion of the traffic portion of a common control central office specification.

4. CHECKLIST OF FEATURES REQUIRED (PARAGRAPH 4)

4.1 Alternate Routing (Paragraph 4.1)

4.11 If paragraph 4.1 is checked in Part III, the common control equipment shall be arranged to provide for at least two alternate routes to the desired destination(s) functioning as covered in paragraph 6.206 of Part I. This should be spelled out in detail in paragraph 10, Part III.

4.2 ANI (Paragraph 4.2)

4.21 If paragraph 4.2 is checked in Part III, the common control equipment will be arranged to identify the calling party on charge dial calls and to transmit this identification to ticketing equipment in the same or a distant office. REA Form 537, "Specification for Equipment for Automatic Number Identification," must be completed and attached.

4.3 Local AMA (Paragraph 4.3)

4.31 If the common control central office is to have local automatic message accounting equipment in conjunction with it, then this paragraph must be checked. A completed REA Form 538, "REA Specification for Equipment for Direct Distance Dialing," must be attached.

4.4 Data Service (Paragraph 4.4)

4.41 When subscribers wish to connect business machines to their telephone lines and have access to other business machines through automatic connections through the switching network on a class of service basis, then paragraph 4.4 should be checked. A detailed description of what is desired should be given in paragraph 10, Part III.

5. MISCELLANEOUS OPERATING FEATURES (PARAGRAPH 5)

5.1 Busy Verification (Paragraph 5.1)

5.11 Busy verification is a feature which permits a toll operator or switchman to override a busy line condition. The purpose is to permit an operator or switchman to determine if a line is out of order or in use. It also permits an operator to verify the charge number given by a subscriber on a toll call. It is essential that precautions be taken to ensure that under no conditions can the busy verification facilities be used by anyone except an operator or supervisory switchman, such as a wire chief or chief switchman.

5.12 The preferred arrangement for common control switching systems is the use of a separate trunk or trunks dedicated to the verification function only, from the operator position to the dial office. Access from the intertoll network directly to busy verification is thereby made impossible. If it is desired to use a two-way trunk for busy verification by the operator, the signaling channel in the opposite direction (from the dial office to the operator switchboard) can be used for intercept or alarm service. If it is desired to use a dedicated trunk or trunks for busy verification, check paragraph 5.111 or 5.112. Access to the busy verification facilities under this condition by the wire chief or chief switchman will be by a multiple appearance of these trunks or by separate dedicated trunks from their location, so indicated by check marks in the proper blanks in paragraph 5.13.

5.13 In the past the universally accepted method of access to the busy verification facilities has been over the regular toll completing trunks, with the operator prefixing the directory number with a single digit. For common control offices this would require the provision of registration and translation facilities which might not be required otherwise, and for this reason the use of a prefix digit (or digits) is not recommended. The connecting company normally provides access information on the 810 form if verification is accomplished by the operator at the toll center.

5.14 If the economies which may be obtained by using the regular toll completing trunks for verification outweigh the cost of the added registration and translation facilities which might be required, or if the use of a digit prefix is necessary to provide a uniform operating practice in a toll switchboard serving other offices using this arrangement, the prefix arrangement may be used. The required prefix should be indicated in paragraph 5.12. REA is attempting, wherever possible, to standardize on the use of digit "0" for this purpose.

5.15 In some cases the problem of distinguishing between incoming operator dialed calls and incoming customer dialed calls, to prevent customers from having access to busy verification on direct distance dialed calls, has been solved by the assignment of a two- or three-digit busy verification code, such as "00" or "000." This arrangement works wherever common control systems are involved, because it will result in more digits being presented to the registration equipment than it is arranged to receive. There will be cases where these codes may result in the false generation of legitimate subscriber numbers, particularly with the proposed expansion of area codes and interchangeability between area and office codes. Accordingly, wherever it appears necessary to use a one-, two-, or three-digit prefix for busy verification, an intensive study should be made to determine if the proposed arrangements will be effective in blocking access to busy verification by customers on direct distance dialed calls. If this proves to be the case, the selected prefix should be shown in paragraph 5.12.

5.16 In areas where the operator positions are in a connecting company office and a prefix code is required for busy verification, the connecting company should be consulted as to what method will be used to prevent customers in the nationwide network from having access to the busy verification feature and the agreed-upon code shown in REA Form 810 should be entered in paragraph 5.12.

5.2 Revertive Calls (Paragraph 5.2)

5.21 The "Directory Number" method is simply the dialing of the called subscriber's directory number; in common control systems it is possible to recognize revertive calls by comparing the line equipment location of the calling line with that of the called directory number. If they are the same, the call is routed to a revertive call trunk, together with the party identification of the called station. When seized, the revertive call trunk is arranged to give a recorded announcement (except single-party when both calling and called phones ring) to the calling subscriber and ring the called station when the calling subscriber hangs up. On answer the trunk is arranged to give either a recorded announcement or a distinctive (tick) tone to the called party. The recorded announcement is desirable but the tick tone is less expensive and probably less of a maintenance problem. If there is a preference for either the tone or the recorded announcement to the called party, it should be indicated in paragraph 5.21 of Part III. If there is another signal which can be agreed on by the suppliers, it must be explained in detail.

5.22 (Paragraph 5.22)

When revertive call service is provided from a group of revertive call trunks, the required number of circuits shall be determined in the following manner: Add the CCS/BH for two- and four-party lines, as obtained from "Total CCS" column, paragraph 2.31 of Part III. If the office is arranged for 100-percent line lockout, and revertive calls are handled on the line circuits after the revertive connection is established, multiply the total CCS/BH by .0075. Otherwise, use .05 as the multiplier. The resulting figure is the CCS/BH the revertive call trunks must handle. For values of CCS up to 40, use traffic table in paragraph 11.14 of Part I of 524 with a grade of service of B.02. The number of reverting call trunks determined in this manner is to be entered in paragraph 5.22, Part III. (Note: A minimum of two revertive call trunks shall be provided.) The multipliers listed above are arrived at by using the following two assumptions:

a. That five percent of the party line traffic will be revertive call traffic.

b. That the average holding time of a revertive call trunk circuit for 100-percent line lockout will be 15 seconds.

5.23 (Paragraph 5.23)

While the service is nowhere recognized as a standard service offering, some operating companies provide single-party lines access to revertive call trunks, for use in providing a form of "intercom" service at the subscriber's premises. The Owner desiring to provide this type of service to his subscribers shall estimate the number of revertive call trunks he will require and enter the required number in paragraph 5.23. Since both phones will ring with the same ring, there is no need for recorded announcement.

5.3 Intercept Facilities (Paragraph 5.3)

5.31 The present criteria for adequate intercepting service for direct distance dialing are: changed number intercept shall be either by an operator or by a recorded announcement with cut-through to an operator; intercept service shall be provided in all cases for vacant codes, disconnected numbers and unassigned numbers, but a recorded announcement will be satisfactory for this service. However, wherever operator intercept can be provided economically it should be specified since it gives the calling subscriber the most satisfactory service.

5.32 A method of handling intercepted calls with a minimum amount of operator work time consists of providing a recorded announcement with cut-through to an operator after a time-out interval.

5.33 The proper blanks in paragraphs 5.31 and 5.32 should be checked to indicate the selected method of handling intercepted traffic. The method to be used for reaching the intercept operator should be indicated by checking the proper blank in paragraph 5.33. When the operator is in the same building, a separate trunk group is preferable. Otherwise, regular interoffice trunks may be used, with a minimum of three trunks arranged for handling intercept.

5.34 When intercepting is handled over regular interoffice trunks, the additional CCS/BH are so low that in most cases additional trunks will not be needed. Where a separate trunk group is provided, one trunk should be specified for each 500 lines or fraction thereof, in the office (with a minimum of two trunks). The proper figure should be entered in paragraph 5.34.

5.4 Line Load Control (Paragraph 5.4)

5.41 As covered in paragraph 7.6 of Part I of the specification, there may be cases where the Owner wishes to specify facilities for giving preference for outgoing service to a limited group of subscribers during emergencies which might stimulate such heavy traffic that essential calls could not be completed. The proper blank in paragraph 5.41 of Part III should be checked to indicate whether or not line load control facilities are required.

5.42 Line load control facilities, if required, may be activated either manually, or automatically with heavy traffic after manually setting a key to put line load control into effect. The method of operation of line load control is not an option which can be specified by the Owner; rather, it is determined by the Bidder in the design of his system.

5.5 Service Observing Facilities (Paragraph 5.5)

5.51 Some operating companies require facilities to be provided to measure the quality of service being given the subscribers by the central office equipment and by the operators. Such measurements are usually on a statistical basis and are obtained by observing the quality of service on a certain percentage of the connections established through the office. Since there are no REA standards established for equipment for providing such facilities, the Owner desiring them should discuss their provision with the REA Area Office and various potential suppliers, explain the details in a note in paragraph 10, and check the proper blank in paragraph 5.51.

5.6 Hotel-Motel Arrangements (Paragraph 5.6)

5.61 Some operating companies offer a service to hotel and motel owners whereby message registers on the premises are provided for each hotel or motel room. The register is operated over a separate conductor from the central office whenever the room occupant completes a directly-dialed local call. There are no REA standards established for such arrangements, so the Owner desiring them should discuss their provision with the REA Area Office and various potential suppliers, explain the details in a note in paragraph 10, and check the "Required" blank in paragraph 5.61. If hotel-motel arrangements are not required, the "Not Required" blank in paragraph 5.61 should be checked.

5.7 Internal Translation (Paragraph 5.7)

5.71 If the rate of growth is low and a small system is fairly stable from a traffic standpoint, the internal translators for subscriber directory numbers (number group) could be eliminated. There could possibly be a saving in overall costs by eliminating an item that would not be used often enough to warrant its inclusion in the office.

6. MAINTENANCE FACILITY REQUIREMENTS (PARAGRAPH 6)

6.1 Alarm Signals (Paragraph 6.1)

6.11 When alarm signals are to be handled locally, it is assumed that someone will always be in attendance to receive them, or else the signals can be sent over a local telephone to the residence of a nearby switchman which will always be attended. It should be

kept in mind, in the latter case, a failure of all ringing supplies will prevent transmission of alarms, unless a special alarm circuit is specified for use along with the local telephone, and dc signaling is accomplished over a third conductor. If alarm signals are to be handled locally, a description of the method to be used should be given in paragraph 6.111.

6.12 When common control central offices are to be arranged for unattended operation, they will be equipped with alarm sending and checking equipment as described in paragraph 8.1, Part I of the General Specification, unless otherwise specified by the Owner. When alarm sending is to be accomplished via operator trunks, paragraph 6.121 should be checked. If a separate alarm sending channel is to be provided, if some other type of trunk is to be used, or if alarm sending equipment of another manufacturer is desired, an explanation should be given in paragraph 6.1221. There are now sophisticated remote alarm systems which have a large number of alarm points in order to provide the maintenance people a more detailed description of the trouble.

6.13 When operator trunks are used for alarm sending, a distinctive tone is given to the operator to indicate that the call being answered is an alarm sending call. The customary tone used for this purpose is the tick tone, and if this is to be used, paragraph 6.1231 should be checked. Cases may arise in certain areas where the use of some other type of tone is considered desirable. In such a case, an explanation of what is required should be given in paragraph 6.1232.

6.14 (Paragraph 6.13)

Carrier and mobile radio groups are sometimes divided into two categories, those that have a lower priority and those that have a higher priority. The lower priority groups should be assigned a minor alarm and the higher priority groups should be assigned a major alarm. If such a distinction is to be made, paragraphs 6.131 and 6.132 should both be checked. If only one category is required, a decision should be made as to what alarm signal is required, and either paragraph 6.131 or paragraph 6.132 should be checked. If priorities are not assigned at the time of the initial installation but may be assigned at a future time, paragraph 6.133 should be checked.

6.2 Trouble Location and Test (Paragraph 6.2)

6.21 Central Office Equipment (Paragraph 6.21)

6.211 Maintenance Center (Paragraph 6.211)

6.2111 Most common control systems make provision for a maintenance center near the trouble recorder. This will include call progress lamps, busy indicator lamps, make busy jacks and alarm indicators for the common control equipment. Test jacks for outgoing trunks may also be provided at this location, as well as the control keys and lamps for a rack-mounted routine test circuit, if one is to

be provided. Normally, test jacks are not provided for intraoffice trunks, since both ends of such trunks can normally be reached by the common control test circuits. If such jacks are desired, they should be specified by the Owner. The Owner and its engineer will be expected to have learned from discussions with potential Bidders what options are available for a maintenance center, and which features are considered by the Bidders to be desirable for their particular systems. In any case, it will be necessary to provide test jacks at some location. Details of the desired maintenance center features should be provided in a note in paragraph 10 of the specification, a check placed in paragraph 6.211 if any type of maintenance center (or equivalent) is to be provided.

6.2112 The Bidder will be expected to provide as part of the maintenance center the test circuits which are necessary for routining and testing the system he is providing (including ANI equipment where provided), unless the Owner specifically indicates otherwise in paragraph 10, Part III. See paragraph 8.213 of Part I, REA Form 524.

6.212 Portable (Paragraph 6.212)

6.2121 In some common control systems the cost of the testing facilities can be materially reduced by providing portable test boxes arranged to make fewer and less sophisticated tests than are available with integrated sender and register pulsing and registration tests, and routine test circuits. This is particularly true if more than one small office of the same type is controlled by the same Owner. Consideration should be given, however, to the fact that portable test equipment requires more frequent maintenance, due to handling and moving. If the Owner desires a Bidder to provide a portable test set for measuring pulsing and registration performance, he should check paragraph 6.2121. If the Owner desires a Bidder to provide a portable current flow test set, for accurately adjusting relays and measuring dc current, he should check paragraph 6.2122. The test set provided by the Bidder should be one that fits in with the apparatus adjusting procedures he recommended for his system.

6.2122 Test sets which are checked under paragraph 6.212 shall be included as part of the basic bid, since they are considered essential to proper maintenance of the system. Of course, if the Owner already has test sets of the desired type in other offices, he will not check the corresponding blanks under paragraph 6.212.

6.22 Outside Plant and Stations (Paragraph 6.22)

6.221 Wire Chief's Test Circuit (Paragraph 6.221)

6.2211 A wire chief's test circuit is an essential item of test equipment, required in every office. If a maintenance center is specified in paragraph 6.2112 it will probably be convenient to include the wire chief's test circuit as part of the center,

in which case paragraph 6.2211 should be checked. If the wire chief's circuit is to be supplied separately, paragraph 6.2212 should be checked. If the Owner wishes to reuse a wire chief's circuit which he already has, no check should be made in paragraph 6.221, and an explanation should be provided in a note in paragraph 10.

6.222 Receiver Off-Hook Tone (ROH) (Paragraph 6.222)

6.2221 An ROH circuit is a useful means for warning a subscriber that his receiver is off-hook. See paragraph 8.222, Part I of the General Specification. It should be borne in mind, however, that a man is usually required at the central office to place the ROH on a line and then remove it, unless a Remote Wire Chief's Test Set is provided from an attended connecting office.

6.2222 The tones to be provided for this office are required to meet the limits specified by the Bell System for their Precise Tone Plan. Accordingly, any ROH equipment specified will be of the type which is compatible with the Precise Tone Plan.

6.2223 When an ROH circuit is provided, it will operate through the wire chief's test circuits, and be arranged to remove tone and restore the line to a serviceable condition automatically when the receiver is replaced.

6.223 Remote Test Set (Paragraph 6.223)

6.2231 This test set is for testing subscriber lines in remote offices (usually unattended CDO's) from a test position in a centrally located office. It provides about the same test facilities for the remote point as the wire chief's test circuit provides for the local central office, including dc tests for grounds and leakage on tip and ring, loop resistance, foreign potentials (ac and dc), and capacitance from tip and ring to ground and between wires. Test commands and test data are transmitted as tones in the voice band over any available voice grade trunk connection (voice, carrier, or radio, or combinations thereof). If this test set is to be provided by the Bidder, paragraph 6.223 should be checked.

6.224 Dial Speed Test Circuit (Paragraph 6.224)

are serveral types of dial speed test sets. The panel
)aragraph 6.2241) is one which is permanently mounted
)ffice and is accessed by dialing a particular digit
.l return to the calling party readily identifiable
:ate that the dial speed is slow, normal or fast. The
)aragraph 6.2242), when used at the central office,
:o read it, as well as someone at the telephone to
.. One of these units may be used to serve several

6.2242 The panel type dial speed test circuit is preferred for common control offices, and if such a set is to be provided by the Bidder, paragraph 6.2241 should be checked. If a portable set is to be provided by the Bidder, paragraph 6.2242 should be checked. If the Bidder is not to provide a dial speed test circuit, neither item should be checked.

6.225 Pushbutton Dialing Test Circuit (Paragraph 6.225)

6.2251 When the office is arranged for pushbutton dialing, paragraph 6.225 should be checked to insure that facilities will be provided by the Bidder for permitting an installer to test for proper functioning of the pushbutton dialing equipment at the subscriber station.

6.226 Additional Hand Test Sets (Paragraph 6.226)

6.2261 One hand telephone test set is furnished with the wire chief's test set. If additional hand test sets are required, the number required should be entered in paragraph 6.226, and an explanation given in paragraph 10, Part III.

6.3 Transmission Tests (Paragraph 6.3)

6.31 Transmission Test Circuit and "Loop Around" Transmission Test Circuit (Paragraphs 6.31 and 6.32)

Close coordination with the requirements of the connecting company is required in specifying these items.

6.311 It is desirable to provide transmission test circuits to permit testing of trunk circuits to and from a distant toll office without any assistance in the local dial office. This is particularly true where the trunks include electronic equipment such as carrier, microwave, or voice frequency repeaters. The equipment is also useful for testing EAS trunks, subscriber loops and station carrier circuits. A detailed description of the testing facilities and the operating requirements is given in paragraph 8.31, Part I of the General Specification.

6.312 If one or both of these test circuits are required, check "Yes" in paragraphs 6.31 and 6.32; otherwise, check "No" in these paragraphs. The frequency or frequencies required and the time interval for application of each frequency should be coordinated with the connecting company and listed in paragraphs 6.31, 6.32, or both.

6.32 (Paragraph 6.321)

6.321 If the distant office is to make loop around tests over one-way out trunks, the one-way out trunks must be seized in the local office in a sequence which can be predetermined. This

requires special arrangements or equipment in the local office; therefore, if this type of operation is desired you must check "Yes" in this paragraph.

6.33 Stability Test Circuit (Paragraph 6.33)

6.331 A circuit for testing the stability of voice frequency repeaters and other electronic equipment may be requested by the connecting company which owns the toll center. A description of this circuit is provided in paragraph 8.33, Part I of the General Specification. If this circuit is required, check "Yes" in paragraph 6.33, otherwise check "No."

7. POWER EQUIPMENT REQUIREMENTS (PARAGRAPH 7)

7.1 Central Office Battery (Paragraph 7.1) (See Paragraph 6.2, Appendix A, Part I)

7.11 Battery Reserve (Paragraph 7.11)

A battery reserve of five busy hours will be adequate for offices located in areas where ac power failures are infrequent and where such power interruptions usually last less than five hours. If an emergency ac power plant is to be used, a battery reserve of three busy hours is sufficient.

7.111 Standby Generator (Paragraph 7.111)

In offices over 1000 lines, or offices including a toll board, or where there are frequent power failures, permanent engine generator units must be provided. Standby engine generators will be purchased separately and not included in the central office equipment specification. Check paragraph 7.111 to show whether an engine generator is to be permanently installed, and fill in the blanks in paragraph 7.11 to indicate the desired battery reserve for an estimated line capacity coincident with the life of the type of battery specified in paragraph 7.12.

7.12 Type of Battery (Paragraph 7.12)

7.121 Both lead antimony and lead calcium batteries are available in the range of capacities required in REA borrowers' dial central offices.

7.122 Lead antimony batteries have an average useful life of approximately ten years when properly maintained and cost about 15 to 20 percent less than the lead calcium type. If they are specified the ampere hour capacity should be just ample to serve the office ten years from the time they are installed.

7.123 Lead calcium batteries have been estimated to have a life as long as 20 years and, therefore, lend themselves for use in those dial central offices only where future requirements for a 20-year period can be closely predicted.

7.124 It appears that maintenance of the two types of batteries is about equal, except that water additions are much less frequent for the lead calcium battery.

7.125 The lead calcium type battery gasses slightly and, therefore, the electrolyte does not get thoroughly mixed for some time after the cells have been on charge following a discharge condition. For this reason, stratification of the electrolyte occurs and a specific gravity reading taken from the top of the cell will not be representative of the condition of the overall cell. Cell voltage readings are usually taken to determine the condition of the battery, instead of specific gravity readings.

7.13 Voltmeter (Paragraph 7.13)

7.131 The voltmeter should be ordered whenever a lead calcium battery is specified and also when a lead antimony battery is specified if it is contemplated that voltage readings will be used in the battery maintenance.

7.14 Hydrometer and Hydrometer Holder (Paragraph 7.14)

7.141 A hydrometer is required if a lead antimony battery is specified. It is not as desirable for use with a lead calcium battery, unless the battery has a special construction so the electrolyte can be accessed at the proper level.

7.15 Battery Rack (Paragraph 7.15)

7.151 The type of battery rack specified should be determined by space considerations. In most cases a two-tier rack will be the best for use in small offices.

7.16 Additional 48-Volt Power Requirements (Paragraph 7.16)

7.161 Any 48-volt dc power requirements necessary for the operation of carrier, voice frequency repeaters, loop extenders, toll board or any other equipment not considered as part of the dial central office equipment should be set forth under this item. The total 48-volt direct current drain of the special equipment in amperes (drain required during ac power failure) is required. The connecting company requirements are available from a properly executed REA Form 810, "Central Office Equipment Engineering Information." These current drains should be the estimated requirements to coincide with the life of the battery.

7.162 Specify in paragraph 7.161 battery and fusing requirements for connecting company equipment and special equipment that is not part of the dial equipment, based on current drain as specified in paragraph 7.16.

7.2 Charging Equipment (Paragraph 7.2)

7.21 Size of Rectifier (Paragraph 7.21)

7.211 The solid state silicon rectifier has become widely used in charging central office storage batteries of the type generally found in REA borrowers' offices. This type rectifier has an average life of about 15 years; therefore, the rectifier supplied should have sufficient capacity to handle the office 15 years after the date of installation.

7.212 Most types of common control central office equipment are not guaranteed to meet the subscriber loop limits of this specification except at float voltage. Therefore, there must be redundancy in the battery charging equipment. In view of this, the requirements of the office should be carefully estimated as additional charging capacity will be provided by the Bidder for backup in case of failure of a charging unit. See paragraph 6.38, Appendix A, of Part I of 524.

7.213 The blank in paragraph 7.21 should be filled in to indicate the estimated number of lines in the office at the end of the rectifier's estimated life.

7.22 Charger Input Rating (Paragraph 7.22)

7.221 The data entered in this paragraph should provide all pertinent information regarding the characteristics of the commercial ac power supply since it will be utilized by the equipment manufacturer in selecting the type of charging equipment with the specified input rating.

7.222 Where a choice of supply is available, the preferred type is 120/240 volt, three-phase, 60 Hz.

7.3 Ringing Equipment (Paragraph 7.3) (See Paragraph 6.4, Appendix A, Part I)

7.31 Frequency and Power Required (Paragraph 7.31)

7.311 Solid state ringing current generators are required by this specification. This type of generator operates directly from the central office battery and is available in any series of frequencies.

7.312 Only the required frequencies should be specified and the power requirements in watts should be indicated for each ringing frequency according to the information contained in REA TE&CM 212, "Ringing Systems." Where possible, the use of the highest frequency should be avoided, to reduce ringing problems from 60 Hz power induction. TE&CM 212 has been revised to reduce each frequency series from five to four by eliminating the present highest frequency of each series.

7.313 In single-party offices, or offices using a single frequency (20 Hz) ringing current with ringing on tip and ring for two-party selective ringing, the proper power requirement in watts should be entered in paragraph 7.31. Since the entire office load must be carried by one generator, the smallest size single frequency generator is 25 watts.

7.32 Frequency Meters (Paragraph 7.32)

7.321 It is necessary to have a means of checking the frequency and the output voltage of each ringing frequency generator. When a telephone company has only one central office, and on all LUS central offices, a panel-mounted set of frequency meters and voltmeter is desirable. In cases where a telephone company operates several SUS offices, it may be desirable to have portable meters. The proper blank should be checked in paragraph 7.32.

7.4 Interrupter Equipment (Paragraph 7.4) (See Paragraph 6.5, Appendix A, Part I)

7.41 Capacity (Paragraph 7.41)

7.411 The number of lines expected to be served by this office at the end of the engineering period (usually 25 years) should be entered in the blank in paragraph 7.41, unless the Owner has reason to provide for a shorter life for the interrupter equipment. This will indicate to the Bidder the load requirements for the interrupter equipment. In single frequency offices larger than 1500 lines, interrupters should be specified which split the ringing load.

7.5 Tone Equipment (Paragraph 7.5) (See Paragraph 6.6, Appendix A, Part I)

7.51 Capacity (Paragraph 7.51)

7.511 The remarks above, in paragraph 7.41, apply also to the ultimate load requirements for the tone equipment, and the line quantity figure which should be entered in paragraph 7.51, Part III.

7.6 Power Board (Paragraph 7.6) (See Paragraph 6.7, Appendix A, Part I)

7.61 Engineered Load Requirements (Paragraph 7.61)

7.611 The supplier will provide a power board containing battery and charger control switches, dc voltmeters, dc ammeters, fuses or circuit breakers, supervisory and timer circuits, as required for proper monitoring and operation of the power equipment. It is required that the power board be of the "dead front" type.

7.612 The power board and associated wiring must be designed initially to handle the exchange when it reaches its ultimate capacity. The number of lines expected to be served by this office when it reaches its ultimate capacity should be entered in the blank in paragraph 7.61.

8. DISTRIBUTING FRAME REQUIREMENTS (PARAGRAPH 8) (SEE PARAGRAPH 9, PART I)

8.1 General

8.11 The standard type of main distributing frame for use on REA borrowers' projects is not equipped with heat coils. All outside plant lines are terminated on protectors on the vertical side and are either equipped with arresters or grounded. All switchboard cables are terminated on connecting blocks on the horizontal side. This provides means for connecting inside and outside plant facilities together by jumper wires. The specification requires that the frame be of the "dead front" type and that adequate facilities for testing all lines be provided. Modern frames of this kind have wire wrapped terminals on both the vertical and horizontal sides. Floor type frames should be provided for common control offices. Main frame protectors makes and and types shall be selected only from REA Bulletin 344-2, "List of Materials Acceptable for Use on Telephone Systems of REA Borrowers."

8.2 Pairs Terminated (Paragraph 8.1)

8.21 All pairs included in the five-year figure should be provided with terminations on the main frame initially. The number of pairs of terminals to be provided initially should be entered in paragraph 8.1.

8.221 (Paragraph 8.11)

The gauge of the outside plant cable at the splice to the tip cable, if one is supplied; otherwise, the gauge at the protector block is to be entered here. The gauge of the outside plant cable is critical in the new high density protectors as there is room for no larger cable than 22 gauge.

8.3 Pairs Protected (Paragraph 8.2)

8.31 All working outside plant pairs must be equipped with acceptable protector mountings and arresters. The number of pairs to be equipped should be entered in paragraph 8.2. All pairs which are terminated but not equipped with protectors must be grounded. It is desirable to provide protector mountings and arresters on all spare pairs if a reasonable quantity is involved. With most designs a detent position is provided in the terminal base portion of the main frame for each arrester pair assembly or each "module" enclosing a pair of arresters. In the detent position, the outside pair is disconnected from the switchboard pair, but the arresters and the ground connections are maintained on the outside pair. Where a large number (100 or more) of spare pairs is involved, a reasonable number of spare pairs should be equipped with arrester assemblies or modules and the remainder of the spare outside pairs should be grounded, preferably by placing wire wrapped grounding straps on the appropriate terminals. The number of terminated but unequipped pairs to be grounded should be entered in paragraph 8.43.

8.4 Additional Protector Pair Units (Paragraph 8.3)

8.41 If the connecting company requires any additional protectors, terminal blocks or verticals on the MDF, specify and explain in this paragraph.

8.5 Main Frame Details (Paragraph 8.4)

8.51 (Paragraphs 8.41 and 8.42)

The total number of arrester units will be the same as the number of protector mountings and cable terminals, unless the grounding of unequipped pairs is done other than by placing arrester assemblies or modules in the detent position. In this latter case it will be necessary to show only the actual number of pairs to be equipped with protectors. If certain types of special electronic or switching equipment are sensitive to surge voltages of less than those specified in Appendix A of Part I, or if the CO is an unattended one located in a high lightning area (see TE&CM 823), then gas tube protectors must be used. Insert the number of gas tube protectors in this paragraph.

8.511 Gas tubes are rated as light, standard, or heavy duty according to their energy handling ability. Their cost is usually directly proportional to this characteristic. Unless extensive power contact exposures or severe lightning problems are anticipated, light or standard duty tubes should be sufficient. Enter in paragraph 8.421

8.512 In station protectors, or other locations where protection of life or a subscriber's property is of prime concern, tubes which fail by the shorted or low breakdown modes* are required. Where only equipment is being protected, however, as in a central office, the user may opt for less expensive tubes which do not guarantee these failure modes but could fail in the high breakdown mode. It should be understood that, should a tube fail in this mode, the equipment which it is protecting will very likely be damaged or destroyed. With tubes of present designs, failure in the high breakdown mode should not be frequent. As a result, a careful consideration of initial tube cost versus damaged equipment replacement cost should be made before indicating a selection in paragraph 8.422.

8.513 If gas tube protection is required because the protected equipment is sensitive to surge voltages less than those listed in Appendix A of Part I, insert the dc breakdown voltage recommended by the equipment manufacturer. If tubes are being specified only to reduce maintenance (as described in TE&CM 823), specify a dc breakdown of 350V.

8.52 Enter in paragraph 8.43 the number of terminated spare pairs to be grounded by means other than the use of arrester assemblies or modules placed in the detent position in the main frame. If none, write "0".

8.53 (Paragraph 8.44)

Factory assembled tip cables tend to reduce workman-caused troubles (such as solder splashes) and may be less costly than if assembled on the job site. Also, termination of outside plant cables on the modern compact MDF's may be difficult, due to the congested wiring, unless the MDF is prestubbed. See paragraph 9.106, Part I of the General Specification. Check the appropriate box in paragraph 8.44 to indicate whether or not a factory assembled tip cable is required.

8.531 The standard length of factory assembled tip cable is 20 feet. If a different length is desired, specify in paragraph 8.441.

8.532 The tip cable can be formed either up or down depending on which direction the entrance cable will approach the MDF.

8.54 Paragraphs 8.45, "Pairs per Vertical," and 8.46, "Height of Vertical," are self-explanatory and should be filled in to meet the particular requirements.

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*These tubes are presently described as "Fail-Safe" by the manufacturers. Due to confusion over this term, its use is being discouraged in favor of the above-mentioned failure modes.

9. BUILDING AND FLOOR PLAN INFORMATION (PARAGRAPH 9)

9.1 General

9.11 The General Specification requires that the Bidder submit a tentative floor plan drawing showing the layout of equipment. See paragraph 10.1, Part I of the General Specification.

9.2 Existing Building (Paragraph 9.1)

9.21 If the equipment is to be placed in an existing building, paragraph 9.1 should be checked and a drawing of the room (or rooms) should be attached. The drawing should show the clear ceiling height, location of any pillars, doorways, windows, radiators, etc., and room dimensions.

9.3 New Building (Paragraph 9.2)

9.31 If a new building is planned, paragraph 9.2 should be checked, and a sketch of the tentative building plan should be shown in paragraph 9.21. Dimensions need not be included, but all available detailed information should be given as to any size and/or shape restrictions which may apply due to lot size, lot location or any other reason, and also to any other restrictions, such as floor loading limitations for instance.

9.32 If the ultimate equipment requirements are very uncertain, buildings are sometimes constructed so that an inside or outside wall can be removed, or a floor added, after 10 to 12 years of growth, to permit further expansion.

9.4 Detailed Arrangements (Paragraph 9.3)

9.41 Partition (Paragraph 9.31)

9.411 Some operating companies provide partitions to isolate the switching equipment from the space occupied by the MDF charger and other equipment to which frequent access is required. This keeps much of the dust and dirt from the switching equipment and tends to reduce its maintenance. The appropriate box in paragraph 9.31 should be checked to indicate whether or not a partition is to be provided.

9.42 Vestibule (Paragraph 9.32)

9.421 Some companies provide a vestibule to prevent dust and dirt from being blown or tracked into the equipment room. The appropriate box in paragraph 9.32 should be checked to indicate whether or not a vestibule is to be provided.

9.422 If "Yes" is checked either in paragraph 9.31 or 9.32, the Bidder will take this into consideration when arranging the floor plan.

9.43 Cable Entrance (Paragraph 9.33)

9.431 The appropriate blank should be checked in paragraph 9.33 to indicate whether the cable entrance is overhead or underground. This will assist the Bidder in arranging the floor plan.

9.44 Additional Space (Paragraph 9.34)

9.441 Any floor space which may be required for carrier, repeater, or any other equipment not furnished by the Bidder should be listed under this item. The connecting company requirements are readily available from a properly executed REA Form 810.

9.5 Van or Trailer Mounted Equipment

9.51 When it is desired that the switching equipment be mounted in a van or in a trailer, this should be indicated in paragraph 10, together with sufficient information to cover the desired placement, and the utility connections available. Local building codes should be investigated before ordering equipment of this type.

10. EXPLANATORY NOTES (PARAGRAPH 10)

10.1 Special arrangements of wiring or equipment not covered in Parts I or III of the specification, but desired in some special situations, should be specifically described under paragraph 10, Part III.

10.2 Any carrier equipment, voice frequency repeaters, standby power plants or other equipment not to be included by the Bidder in his basic bid should be purchased under a separate special equipment contract. This equipment should not be included in the "Common Control Central Office Equipment Specification."

10.3 Any of the preceding items in this Application Guide which require further explanation should be covered in paragraph 10.

10.4 The enclosed Part IV, REA Form 524d, shall be filled in by each Bidder and returned with his bid.

11. ALTERNATE REQUESTS

request for additional prices on equipment not specified main section of Part III is necessary, it must be done paragraph. This covers equipment which may or may not be the contract depending on price. The number of alternates ept to a minimum.

APPENDIX

TRAFFIC WORK SHEET #1
GENERAL TRAFFIC DATA

By Allm Date 7-4-75 Project No. 500
Chkd. By _____ Date _____ Office Name Dead Cow

1. Telephone Company Peyaugh Telephone Company
2. Office Name Dead Cow, Kansas
3. Area Code 302 Office Code 692
4. Number of Lines: Initial 3000
   Ultimate 6000
   Pay Stations 40
5. Number of Lines: Rotary Dial Telephone 1960
   Pushbutton Telephone 1040
6. Originating Calling Rate - CCS/Line 1.34
7. Originating Lines Traffic - CCS (Item 2.31d, Adjusted) 4020
   7.1 Originating Pay Station - CCS (1) 72
   7.2 Operator Assist. Traffic - CCS (2) 332 x .2 = 66
8. Outward Traffic - CCS (3) 66+1110+330+266-280=2042
9. Intraoffice Traffic - CCS (4) 4020-2042=1978
10. Adjusted Intraoffice Traffic - CCS or 40% of (7), Whichever is Larger 1978

Item 3.111

10.1 Pay Station Intraoffice Traffic-CCS = $\frac{(7.1)\times(10)}{(7)} = \frac{72 \times 1978}{4020} =$ 35

10.2 Non-Pay Station Intraoffice Traffic-CCS = (10)-(10.1) = 1943

(1) Item 2.31
(2) 0.5 x (2-Way Toll-CAMA) or .2 x TSPS Traffic
(3) Operator Assistance + Outgoing EAS + CAMA + PPCS - Tandem
(4) (7) - (8)

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Office Name (By Location) Dead Cow

2.24 Type of Pay station Prepay

2.25 Percent of Lines with Lockout 100%

2.3 Traffic Data

2.31 Originating Traffic-Estimated per Busy Hour

	(a) CCS Per Main Station	(b) No. of Main Stations	(a x b) Total CCS	(3) No. of Lines Required
Ind.-Res.	1.2	2330	2796	2330
Two-Party - Res.				
Ind.-Bus.	1.8	610	1098	610
Two-Party - Bus.				
Four-Party				
Pay Station	1.8	40	72	40
Tel. Co. Official	2.0	2	4	2
Wire Chief	1.2	1	1.2	1
Nbr. Htg. or				
Non-Centrex PBX	4 (1)	10 (2)	40	10
Centrex PBX				
Trunks	(1)	(2)		
Extensions				
WATS				
Data Service				
Total		2993 (c)	4011 (d)	2993 (e) (4)
		4000 (5)		

Note 1: This figure is the CCS per PBX trunk.
Note 2: This figure is the number of PBX trunks (attendant trunks in the case of Centrex).
Note 3: See Part III, paragraph 2.1.
Note 4: This is the total of line relay equipments required. The number to be provided will be determined by the class of service requirements and the equipment design of the system of the selected Bidder. See Part IV, paragraph 3.2.
Note 5: Number of directory numbers required is (c) plus 10 percent rounded to next 100 numbers.

Office Name
(By Location) Dead Cow

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2.32 Average Originating CCS Per Line Per Busy Hour

$$\frac{(d)}{(e)} = \frac{4011}{2993} = \text{CCS/Line } 1.34$$

This office shall be engineered to handle an initial average originating busy hour traffic of 1.34 CCS per line. It is anticipated that the average originating busy hour traffic will increase in 5 years to 1.4 CCS per line, and ultimately to 1.6 CCS per line.

2.33 Terminating Traffic - Estimated CCS Per Busy Hour

2.331 It is assumed that the total CCS for terminating traffic is the same as for originating traffic. Since common control switch networks are on a terminal per line basis, the terminating CCS per line will be the same as the originating CCS per line as shown in paragraph 2.32, unless PBX traffic is segregated in certain switch units.

2.34 Segregated PBX Traffic

2.341 Where the PBX traffic is not distributed at random over all switch units, it shall be the responsibility of the Bidder to calculate the traffic for the various switch units so to achieve the desired grade of service.

2.35 Percent of Pushbutton Lines 33%

2.36 Anticipated Ultimate Capacity (25 Years)

2.361 Subscriber Lines _____

2.362 Subscriber Directory Numbers _____

Office Name
(By Location) Dead Cow

3. TRUNK CIRCUIT REQUIREMENTS

3.1 Interoffice Trunking

3.11 Trunking Requirements

1. Connecting Office	NORTH	NORTH	NORTH	
2. Use of Trunk	EAS	EAS	EAS	
3. Quantity Equipped	5	15	12	
4. Ultimate % Growth	100	100	100	
5. CCS Capacity	Combined	332	228	
6. Direction	Two-WAY	OUT	IN	
7. No. Digits Dialed	7	7		
8. No. Digits Outpulsed	5	5		
9. No. Digits Inpulsed	5		5	
10. Type Signaling	LOOP	LOOP	LOOP	
11. Type Pulsing	DIAL	DIAL	DIAL	
12. Carrier				
13. Physical	X	X	X	
14. Repeat Coils (1)	X	X	X	
15. DX Signaling Set				
16. Other Type Signaling				
17. Delay Dial				

Refer to the attached REA Form 810 for connecting company trunk circuit drawing numbers and name of manufacturer.

Note 1: Omit repeating coils for carrier derived trunks. Carrier supplie will provide A and B leads if required.

Office Name
(By Location) Dead Cow

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3. TRUNK CIRCUIT REQUIREMENTS

3.1 Interoffice Trunking

3.11 Trunking Requirements

1. Connecting Office	EAST	WEST	WEST	
2. Use of Trunk	EAS	EAS	EAS	
3. Quantity Equipped	38	21	25	
4. Ultimate % Growth	100	100	100	
5. CCS Capacity	730	413	526	
6. Direction	Two-WAY	OUT	IN	
7. No. Digits Dialed	7	7		
8. No. Digits Outpulsed	5	5		
9. No. Digits Inpulsed	5		5	
10. Type Signaling	Loop DIAL	Loop DIAL	Loop DIAL	
11. Type Pulsing	DIAL	DIAL	DIAL	
12. Carrier	X	X	X	
13. Physical				
14. Repeat Coils (1)				
15. DX Signaling Set				
16. Other Type Signaling				
17. Delay Dial				
* TANDEM CCS	280	140	140	

* Included in traffic above.

Refer to the attached REA Form 810 for connecting company trunk circuit drawing numbers and name of manufacturer.

Note 1: Omit repeating coils for carrier derived trunks. Carrier supplier will provide A and B leads if required.

Office Name
(By Location) DEAD COW

3. TRUNK CIRCUIT REQUIREMENTS

3.1 Interoffice Trunking

3.11 Trunking Requirements

1. Connecting Office				
2. Use of Trunk	CAMA	TSPS	Toll Comp. HU	Toll Comp. E
3. Quantity Equipped	37	18	32	10
4. Ultimate % Growth	100	100	100	100
5. CCS Capacity	880	332	1070	132
6. Direction	OUT	OUT	IN	IN
7. No. Digits Dialed	8/11	1 or 8/11		
8. No. Digits Outpulsed	7/10	7/10		
9. No. Digits Inpulsed			4	4
10. Type Signaling	E+M	E+M	E+M	E+M
11. Type Pulsing	MF	MF	MF	MF
12. Carrier		X	X	X
13. Physical	X			
14. Repeat Coils (1)	X			
15. DX Signaling Set	X			
16. Other Type Signaling				
17. Delay Dial			X	X

Refer to the attached REA Form 810 for connecting company trunk circuit drawing numbers and name of manufacturer.

Note 1: Omit repeating coils for carrier derived trunks. Carrier supplier will provide A and B leads if required.

Office Name
(By Location) Dead Cow

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3.2 Trunk Traffic

3.21 Originating Traffic

Type	CCS	H.T. Secs.	BHC	No. Digits Outpulsed	Pulsing Mode	Remarks
Toll "0"- (1)	66	300	22			
Toll "0"+7(1)(2)	178	270	66	7	MF	
Toll "0"+10(1)(2)	88	270	33	10	MF	
Toll S-S "1"+7(2)	590	240	246	7	MF	
Toll S-S "1"+10(2)	290	240	121	10	MF	
Special Service						Over O-
Intercept						Over O-
Intraoffice	1978	120	1648			
EAS NORTH	332	150	221	5	DP	
EAS EAST	225	150	150	5	DP	
EAS WEST	273	150	182	5	DP	
TANDEM	280	150	187	5	DP	
Total	4300		2876			

Busy Hour Attempts = BHC Total x 1.2 = 3451.

(1) PPCS traffic assumed to be divided 20 percent "0"- and 80 percent "0"+ if unknown.

(2) Toll calls assumed to be divided two-thirds 7 digits and one-third 10 digits.

3.22 Intraoffice Traffic

3.221 Intraoffice trunk groups are required for the following traffic:

Type of Trunk	CCS
Non-Pay station	1943
Pay station	35
Other (Explain in para. 10)	

Office Name
(By Location) DEAD COW

3.3 Terminating Traffic

Type	CCS	H.T. Secs.	BHC	No. Digits Inpulsed	Pulsing Mode	Remarks
Toll Compl.	1202	240	501	4	MF	
Toll Switch						
Test & Ver.						
Intraoffice	1978	120	1648			
EAS NORTH	228	150	152	5	DP	
EAS EAST	225	150	150	5	DP	
EAS WEST	386	150	257	5	DP	
TANDEM	280	150	187	5	DP	
Total	4299		2895			

4. CHECK LIST OF FEATURES REQUIRED

4.1 Alternate Routing (Explain in paragraph 10) ☐

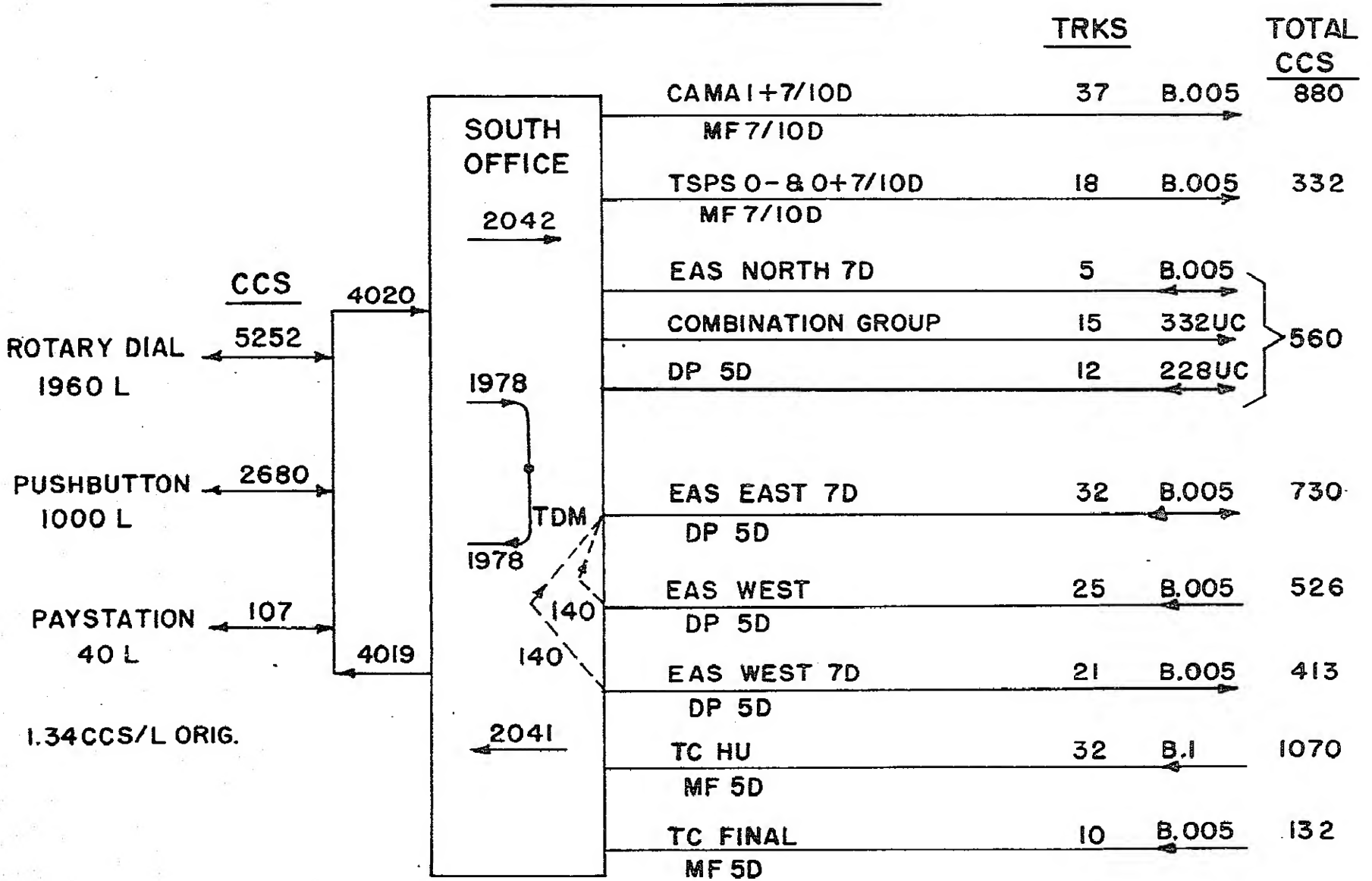
4.2 ANI (REA Form 537 must be attached) ☐

4.3 Local AMA - Ticketing (REA Form 538 must be attached) ☐

4.4 Data Service (Describe in paragraph 10) ☐

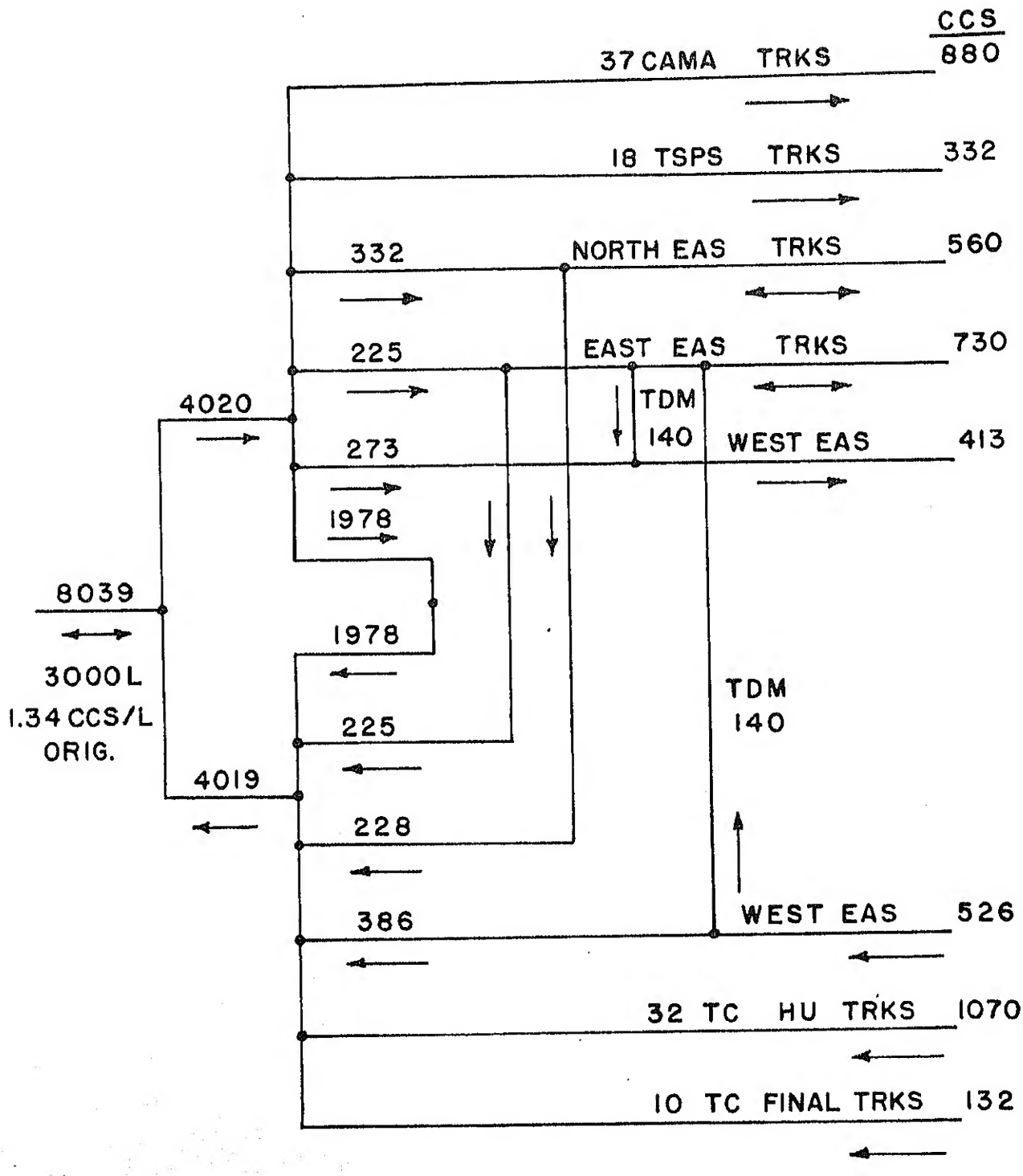
TYPICAL OFFICE BLOCK DIAGRAM

KANSAS 500 DEAD COW



TRAFFIC FLOW

KANSAS 500 DEAD COW



WORK SHEET #2

ORIGINATING TRAFFIC

CAMA	880 CCS
TSPS	332
EAS - East	225

$\frac{1}{2}$ (Total CCS) - TDM
$\frac{1}{2}$ (730) - 140

EAS - West	273

Total CCS - TDM
413 - 140

EAS - North	332

Equivalent # Trunks =

$$2W \left(\frac{1W/OG}{(1W/OG + 1W/IN)} \right) + 1W/OG$$

Equivalent # Trunks =

$$5 \left(\frac{15}{(15 + 12)} \right) + 15 = 18 \text{ Trunks}$$

Total Out CCS 2042

Line Orig. = 3000 Lines x 1.34 CCS/L = 4020 CCS

Intraoffice CCS = 4020 - 2042 = 1978

WORK SHEET #3

TERMINATING TRAFFIC

Type of Trunk	CCS
Toll Compl. HU + Final 1070 + 132	1202
EAS - East $\frac{1}{2}\left(\frac{\text{Total CCS}}{730}\right)$ - TDM $\frac{1}{2}$ (730) - 140	225
EAS - West Total CCS - TDM 526 - 140	386
EAS - North Equivalent # Trunks = $(2W)\ \frac{1W/IN}{1W/OG + 1W/IN}$ Equivalent # Trunks = $5\left(\frac{15}{15 + 12}\right) + 12 = 14$ Trunks	228
Tandem	280
	2321

Terminating Intraoffice Traffic = Originating IAO Traffic

IAO = 1978